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CHEMICAL & METALLURGICAL ENGINEERING

VOLUME 37 NUMBER 6

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S. D. KIRKPATRICK, *Editor*

June, 1930

Industry Appraises the Product Of the Technical School

THIS MONTH 40,000 graduates leave the universities and colleges of this country. Perhaps 4,000 of these are chemists and chemical engineers, and, except for the ten or twenty per cent who are returning for graduate study, most of the others are entering the major industries largely as the result of systematic, well-organized recruiting. Industry has studied the product of the technical school and has not hesitated to apply modern business methods in the competition to get the best the colleges have to offer. It is interesting, however, to note the changing criteria by which values are established in this highly competitive market.

TWENTY YEARS AGO, the best jobs were likely to go to those who stood highest in their classes. Unless a man's scholastic record would withstand careful scrutiny, the professor was likely to recommend the employment gate in the yard or the night shift in the steel lab. During and after the War, a change was noticeable. Emphasis shifted to personality; campus activities and social achievements received relatively more consideration than good grades and classroom honors. The rapid growth of chemical industry had resulted in a multiplicity of managerial positions, and the representatives of industry were looking for embryonic executives. Now, the pendulum is swinging back. Personality still counts, but there is recognition of the fact that thoroughness of training is the most substantial foundation on which to build the technical executive. The old idea was that the "encyclopedia" type of chemist or the "walking handbook" engineer could be picked up on any crossroads, while the glib-tongued "leader" was the rare specimen to be sought at any price. Today, values are determined differently.

SALARY STUDIES recently made for this year's graduates from six leading engineering colleges in the East, show that while the median (not the average) salary paid was below $1,600, the median for the ten per cent highest in scholarship was more than $2,000. In one of the schools comparable figures were $1,620 and $2,220. In other words, while fifty per cent of the graduates were getting below $1,620, the upper five per cent were receiving in excess of $2,220—a bonus of thirty-five per cent for scholarship.

SUCH SALARIES, resulting from the orgy of competitive bidding, tend to put false ideas in the minds of some of these younger men. It is right that up to now they should have held the upper hand and have selected their jobs just as carefully as the company selected its men. Dr. M. C. Whitaker, experienced as both maker and user of the products of the chemical engineering school, has said that the first step toward a technical man's success is picking the right boss. But once that is done, the young graduate becomes a part of a great industrial mechanism in which he advances only as he helps advance the whole machine. It is up to him now to justify somebody's investment in his business potentialities.

EDITORIALS

JUNE, 1930

Reassuring the Users Of Industrial Alcohol

AS THE SMOKE of battle clears away it becomes evident that legitimate chemical industry is not likely to suffer—in fact, may even gain considerable advantage—as a result of the recent transfer of the prohibition enforcement machinery from the Treasury to the Department of Justice. In the competent and experienced hands of Dr. James M. Doran, now Commissioner of Industrial Alcohol, industry has little to fear in the matter of radical administration. The reassuring attitude of the Assistant Attorney General, as well as the recent favorable decision of the Supreme Court in expediting the renewal of alcohol permits, are additional reasons for confidence on the part of industries dependent on the use of this essential chemical raw material. With prohibition enforcement passing through its most critical stage as a result of better informed public opinion, there is good reason to believe that the day of fanatical persecution is definitely a thing of the past.

Coal Study Insured By Generous Gifts

CARNEGIE INSTITUTE OF TECHNOLOGY can well take pride in the prospect of a splendid coal research program now assured by generous gifts amounting to nearly a half million dollars. President Baker, who far-sightedly planned the two International Coal Conferences, is now given an opportunity to contribute from his own institution new knowledge of great value.

The scope, and even the general direction, of these investigations cannot now be forecast. Their nature undoubtedly will be determined primarily by the man selected to head the project. It is to be hoped that a chemical engineer of outstanding ability will be found available for this task, so that all phases of development, processing, and utilization of coal may be rightly appraised in their relation to the need for new knowledge. The task will not be an easy one, but the results of a wisely directed research can become of greatest value, fully warranting the large expenditures contemplated during the five-year program now assured.

Ammonia as a Heavy Chemical

AMMONIA'S uses are many in industry and they are constantly on the increase. This fact was clearly demonstrated in an outstanding paper presented by Jasper E. Crane, of the duPont company, at the recent meeting of the Manufacturing Chemists' Association. Such fields as metallurgy and sanitary engineering, as well as numerous other branches of technical business, are becoming important users of ammonia as a result of the availability of this new synthetic at reasonable cost.

Among the most attractive of the newer uses for ammonia is its application as a source of hydrogen, particularly for welding. Simple, inexpensive apparatus has been developed for cracking the gas by use of an electrically heated catalyst. One cylinder of ammonia, when cracked, is equivalent, according to Mr. Crane, to about seventeen cylinders of hydrogen. As the principal part of the cost to the user of hydrogen is the cylinder cost, the cracked gas costs him only about one-half as much as the cylinder product.

An even more striking reduction in cost is that of nitrogen made by the cracking process. The cracked gases are burned in air, producing water and nitrogen. One cylinder of ammonia, in this case, is equivalent to about thirty-six cylinders of nitrogen at one-ninth the cost.

Other better-known uses, of course, are much more important as tonnage markets for ammonia. These include the production of synthetic organic chemicals in great variety; nitric acid and synthetic sodium nitrate; fertilizers; nitrided metal products; uses as a cheap alkali (only lime is cheaper) for such neutralizing operations as in reducing corrosion in oil pipe lines and refineries; and use in water purification to decrease chlorine requirements. Ammonia manufacturers have, within a remarkably short time, brought the price of their product within the reach of all these uses. Two factors, far-seeing market development policies, and chemical engineering initiative of an exceptional sort, are the magic behind this success.

German Chemical Industry in 1929

FROM the Department of Commerce and William T. Daugherty, its trade commissioner in Berlin, comes another of the reports on "German Chemical Developments," that now have the fortunate habit of appearing annually. The excellent work of interpretation and coverage represented by these bulletins is this time concerned with the year 1929, in which several significant features are conspicuous among the numerous technical and economic movements.

Of the total German chemical production of four billion marks, the nitrogen products, the most important and interesting, economically, account for about one-fifth, while dyes, the pre-war leaders, represent one-eighth. Manifestly, then, the developments of the industry as a whole are largely influenced by these large single factors, preponderantly nitrogen. Thus, it is found that, on a basis of 1913, the chemical price index was 119 in 1929, against 150 as a general price index; this is also considerably lower than the indices in France, the United States, and Great Britain. Accounted for in part by the reduced nitrogen prices last July, it represents a low "value added by manufacture" as well as cheap labor—that is, technical proficiency plus low wages. Similarly, the fact that one-third of Germany's chemical production is exported, reflects in part the 300,000 tons of nitrogen products that leave the country. That nitrogen has more than compensated for the reduced position of dyestuffs is further shown by the constantly improving trade balance: the excess of exports over imports of chemicals

increased by 55 million marks over 1928, and the respective portions of the foreign trade represented by chemical industry in 1929 was eleven and two and four-tenths per cent, compared with nine and four per cent in 1913. Chemical industry ranked third during 1929 in supporting Germany's trade balance.

The nitrogen situation has also involved the I.G. chemical trust in several international agreements and parleys. With production approaching saturation, a ten-year propaganda pact was formed with British and Chilean producers, Norsk-Hydro joining directly afterward. Meanwhile, independent German producers became a menace to the trust through new technical improvements, but eventually entered a five-year agreement last December, giving the I.G. control of the output and German producers a united front to the rest of the world.

Independent nitrogen producers, especially those in the Ruhr district, in Silesia, and at Rauxal, are responsible for employment of several new processes, two drawing on American developments. They are individually considered in Mr. Daugherty's report, but it may be remarked that their production costs in themselves are said to be below the I.G.'s. Another technical movement is that of the energetic Wintershall potash concern, which began nitrogen fixation for combination with potash as a concentrated fertilizer.

Several German developments—e.g., hydrogenation of coal and oil—gained access to this country during 1929, but a number of significant invasions in the other direction are now reported. Two nitrogen processes, already mentioned, represent an advanced ammonia synthesis and oxidation; further processes are one for contact sulphuric acid, another for formaldehyde plastics, another for pyroxylin lacquers, and still others for less significant industries. Meanwhile, American chemical sales in Germany have grown to about 20 million dollars annually—evidence that American materials are keeping pace with American ideas as an object of demand in the country where chemistry has become a traditional mainstay.

Commendable Frankness In Naming Materials

TODAY there is an evident trend for accurate and significant names of products. The majority of alloys that are almost daily appearing on the market are given appropriate names, but some of the new and even many of those of long-time use have names that are misleading. German or nickel silver is an outstanding example of the latter. It is common knowledge that this type of alloy contains no precious metal; and the name is extremely misleading. If we are to follow the trend of synthetically exact designation of materials, it is time that this product be described more rationally. Furthermore, there remain in chemical industry many other queer and unwarranted names, which are no more justified than is German silver for a nickel-copper alloy. Producers of this material, and other concerns facing like problems among chemical commodities, will be doing a real service if they recognize the trend of the day and give their products precise and significant names.

M.C.A. Chooses New Executive Secretary

WARREN N. WATSON has been named as the executive secrtary of the Manufacturing Chemists' Association, with headquarters in Washington, D. C., where he assumes the position left vacant some months ago by the death of John I. Tierney. In this selection, the association secures the service of a man who has already demonstrated his capacity for broad, yet thorough, study of chemical industries, and a man entirely capable of serving the many ramifications of chemical manufacture in relation to Washington affairs.

Chemical industry has changed radically in the past decade. Its problems have multiplied and have grown in importance, not only to the manufacturing concerns themselves but also to the public. Economic trends as well as technologic developments demand day-to-day attention. Many of the questions which arise can be handled profitably for the industry as a whole. This does not do away with the necessity for eternal vigilance on the part of each individual company, but it does materially lessen the burden by having a sound foundation laid for the entire group.

Chem. & Met. congratulates and expresses its best wishes, both to Mr. Watson in his new position and to the association on securing such a capable representative. The result of this selection will be forward-looking and constructive public service.

A New Tariff Law of the Land

AS WE go to press, the sagest of the political prophets hold that the errant bill known as the Hawley-Smoot Tariff is to become the law of the land. Whether it does or not, makes little difference to chemical industry except in its hazy relation to business as a whole. A careful analysis of this legislation, appearing elsewhere in this issue, reveals that only very minor alterations have been written into the chemical schedules, despite the barrage of informed and uninformed criticism that has been launched against the measure.

Of the 556 items in the chemical schedule, only 47 have been increased while 66 have been decreased. The latter apply for the most part to commodities of trivial importance except in the case of fertilizer ingredients. This same patronizing attention to the farmers' needs has been responsible for increased duties on certain chemical raw materials of agricultural antecedents, but in most cases compensatory duties are provided for the finished products. An admitted improvement in the so-called flexible provision holds promise for a better and prompter adjustment of the inevitable inconsistencies.

Withal, it is well to remember that, like other political issues, the tariff is not nearly as vicious as its opponents have made it out to be. It is not as drastic a measure as was its predecessor, against which the same threats were made of foreign reprisals and consequent injury to foreign trade. Neither materialized, for very good reasons. The Tariff Act of 1930, if such it is to be, will neither make nor break chemical industry.

Plant of the Great Western Electro-Chemical Company in Pittsburg, Calif.

Pacific Coast Industry Diversifies Products

By PAUL D. V. MANNING
Pacific Coast Editor, Chem. & Met.

PACIFIC COAST increase in population and the subsequent industrial growth presaged the development of a modest chemical industry some years ago. Most of these enterprises, established to produce one or two commodities, have grown enormously, and accompanying this growth has been a marked diversification of products. This diversification is still going on and several chemicals are now commercially produced for the first time in this country by Pacific Coast plants. For the most part this is due to the factors of opportunity, raw materials, freight rates from the East, and local demand for the product.

The plant of the Great Western Electro-Chemical Company is in Pittsburg, Calif., about 40 miles northeast of San Francisco, at the junction of the San Joaquin and Sacramento rivers, both of which are navigable to ocean vessels. The plant site consists of 55 acres. The river water is available for plant use in part, and company wells supply water for purposes requiring a better grade of water. Two transcontinental railroads serve Pittsburg, while a third railroad serves it from local California points.

Sources of most of the raw materials are within a short distance and hydro-electric power supplies the energy. Fuel oil is brought in by oil-company barges from Martinez, a short distance down the bay, and natural gas at low cost is available from the San Joaquin Valley fields. A good class of labor supplies the 225 men employed.

Products of the company with maximum manufacturing capacities per day are given in the following table:

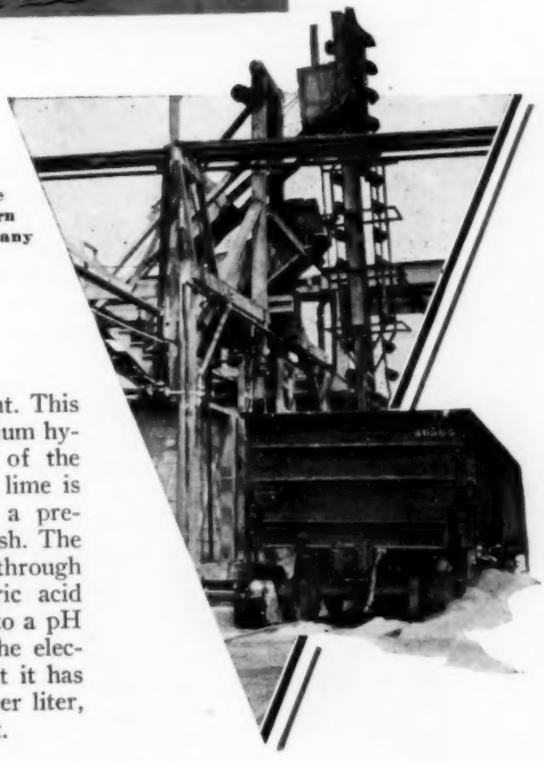
Electrolytic caustic soda	40 tons (13 tons as solid)
Electrolytic chlorine	35 tons
Hydrochloric acid (31 per cent)	18 tons
Causticized caustic soda	25 tons
Anhydrous ammonia	5 tons
Liquid sulphur dioxide	5 tons
Sodium xanthate } Potassium xanthate }	15 tons
Alkyl xanthates	1 ton
Bleaching powder	27 tons
Ferric chloride	5 tons
Diammonium phosphate	6 tons
Zinc chloride	15 tons
Aqua ammonia	3,000 lb.
Sodium hypochlorite (16 per cent)	1,000 lb.

The electrolytic caustic-soda plant consists of twelve banks of Allen-Moore cells, each bank having 64 cells.

The cells in each bank are arranged in series. Each freshly cleaned cell is put into operation with a terminal voltage of 3.5. As the operation proceeds, it is necessary to raise the voltage gradually until it reaches 4 volts per cell, at which time the bank is again taken off the line for cleaning. The average potential required per bank is 240 volts.

Sodium chloride used as a raw material is produced in great quantities around San Francisco Bay through the solar evaporation of sea water. This material with a specified maximum content of calcium and magnesium, is shipped to the plant by train from Newark, Calif. It is dissolved in river or well water and the brine thus formed is purified by the addition of some of the return

Pittsburg Is Conveniently Located in Respect to San Francisco, as Shown in Shell Company Map



Unloading Salt at the Plant of the Great Western Electro-Chemical Company

▼

salt from the evaporating plant. This return salt carries enough sodium hydroxide to effect a removal of the magnesia in the liquor. The lime is removed by the addition of a predetermined quantity of soda ash. The purified brine is then passed through a sand filter and hydrochloric acid is added to bring the acidity to a pH of 3. It is then ready for the electrolytic system. At this point it has a salt content of 300 grams per liter, or approximately 26 per cent.

The amount of current passed through the cells is determined by the estimated chlorine production required. It varies from 900 to 1,600 amp. The cells are made of concrete, the average life being five years. The graphite anodes and the diaphragms, which are made of a double layer of asbestos paper, last about a year. A graphite shop provides the anodes for the cell house. The cathodes consist of Armco iron plates with herringbone perforations.

Electrical energy comes to the plant at 22,000 volts, three phase, 60 cycles. It is transformed to current at 190 volts with an efficiency of 98 per cent and is then converted to 240 volts direct current. This is accomplished at an efficiency of 94 per cent by twelve 405-kva. rotary booster converters. A 95-per cent current efficiency is obtained in the electrolytic cells. Two spare converters provide for emergencies.

As the electrolyzed brine leaves the cells and passes to the evaporating system, it contains 110 grams of caustic soda per liter and 170 of sodium chloride. The evaporating system consists of two sets of 96-in. Zaremba double-effect evaporators with salt baskets, which are operated as batch concentrators. A full load of weak liquor is equivalent to one panful of 50 per cent solution. When a salt basket is full, it is washed out and the salt dissolved. This solution goes to the brine tanks for use in purifying the raw brine.

Each batch-evaporation cycle requires five to six hours, 12 tons of 50 per cent concentrate liquor resulting. This is known as "blue liquor," because of the presence of a small quantity of sodium ferrate, which gives a blue tint to the liquor. Formerly the concentrate was run into cooling tanks, where air from coils was bubbled through for cooling, but now the salts are removed and the liquor cooled in Swenson-Walker continuous crystallizers.

Most (80 per cent) of the caustic used by local industries is marketed as a 50-per cent solution and finds its principal uses in the petroleum-refining and soap industries. When concentrated to 50 per cent the non-insoluble excess salts are salted out, washed, and returned to the brine system. The major part of the concentrate is then ready for the market, while the remainder, equivalent to 13 tons of solid caustic per day, goes to the fusion pots for production of fused solid and flake caustic. The hand-ladling system is used.

The fusion plant consists of eight Bufflovak pots, 10 ft. in diameter. They are arranged, five in front and three in the rear of an oil-fired furnace. The Dubbs oil used for fuel is supplied from the Martinez refinery of the Shell Oil Company.

Drums for use in shipping the solid caustic are manufactured in the plant with the use of Stoll machines. The sheet iron employed is obtained from a near-by manufacturing plant of the Columbia Steel Company.

Synthetic ammonia is produced in a modified Haber process plant. The hydrogen produced as a byproduct in the electro-

lytic plant is collected, metered, and mixed with air in the proportion of about 75 per cent of the former. Nash Hytor pumps are used to handle the air and hydrogen. Control of the gas mixture is obtained through an Engelhard hydrogen-analyzer set. After removal of the oxygen, the residual gases are cooled with water, and scrubbed first with a 10 per cent solution of caustic soda and finally with water, before being passed to the mixed gas holder. The cooler and scrubbers are about 3x15 ft.

Drawing on the mixed gasometer, four-stage Ingersoll-Rand compressors finally deliver the nitrogen-hydrogen mixture at a pressure of 4,000 lb. At this pressure, it is passed through one of two soda-lime towers, each 16 in. by 8 ft., one of which is in service while the other is being recharged. After this final purification the gas goes direct to the circulating system, which is operated by Ingersoll-Rand circulating pumps. In this circuit the gas passes to the convertor chambers, where the union of nitrogen with the hydrogen is catalytically carried out. The catalyst used is a coarse reduced iron. In charging the catalyst chamber, coarse, fused, synthetic magnetite (magnetic iron oxide) is placed in the steel-screen basket and reduced to the metallic state by slow passage of the gas mixture. When properly reduced, the iron is pyraforic. The life of the catalyst is about one year. It gives a 10-per cent conversion in the first pass.

Sufficient heat is produced by the reaction forming the ammonia to maintain the gases in the catalyst chamber at 550 deg. C. Electric elements are placed in the chamber to start the reaction after a shutdown. These consist of the ordinary commercial space heater units in the gas space. The apparatus is constructed of a special nickel-chrome-vanadium steel.

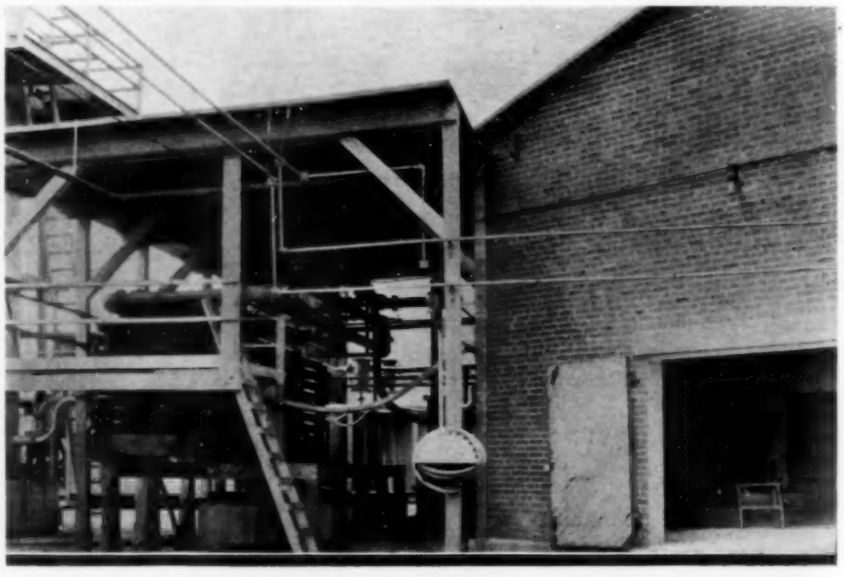
The partly converted gas passes to a double pipe-type heat exchanger and to the cooler and liquefier through a catch pot, which removes the ammonia. Approximately 90 per cent of the gas then returns to the circulating pump for further passage through the catalyzer. The argon is bled off at the cooler and liquefier.

The first 2½-ton unit was placed in operation in January, 1927, and the second in 1928. Production of each ton of ammonia requires 100,000 cu.ft. of hydrogen. The entire production is marketed on the Pacific Coast, mostly in the anhydrous form, although a small quantity of aqua ammonia is produced and sold to yeast manufacturers. In making aqua ammonia, use is made of the non-condensible gases containing ammonia, from cooler and liquefier as well as from the cylinder-filling operation. These are called "snift gases."

By far the bulk of the chlorine produced is liquefied and sold in Pacific Coast markets. Formerly, most of it went into the manufacture of bleaching powder as chloride of lime, but of late the production of this has been cut to 100 tons per month. A small quantity of sodium-hypochlorite solution for bleach is manufactured, but most of the former users of bleaching solution and bleaching powder now use liquid chlorine, of which 35 tons daily is produced.

The electrolytic cell gas from the chlorine side, containing 88-90 per cent chlorine—the remainder air and CO_2—is handled by eight iron Nash pumps, working at 5 to 6 lb., and is pulled through stoneware, Raschig ring filled, 3x4-ft. drying towers. The drying agent used is sulphuric acid.

Dry chlorine gas is next compressed to 100 lb. by a battery of six single-stage compressors. These compressors were designed and built by the company. Each chlorine circuit is provided with its own line to the drying towers, where all are linked together. A double-pipe brine cooler, operating at —20 deg. C. liquefies the chlorine, which is about 93-94 per cent of the gas. Of the 7 per cent returned, 30 per cent is chlorine. This also includes the air-chlorine mixture resulting from the filling of shipping containers. The total mixed low concentration gases are classified as "snift gas." Refrigerated brine for the chlorine liquefaction is provided by two York units with a total refrigerating capacity of 75 tons daily.



The Liquid Sulphur Dioxide Plant. The Gases From the Burner Pass Through a Cast-Iron Condenser, Where They Are Cooled by Air and Then by Water While Passing Through a Lead-Pipe Cooler.

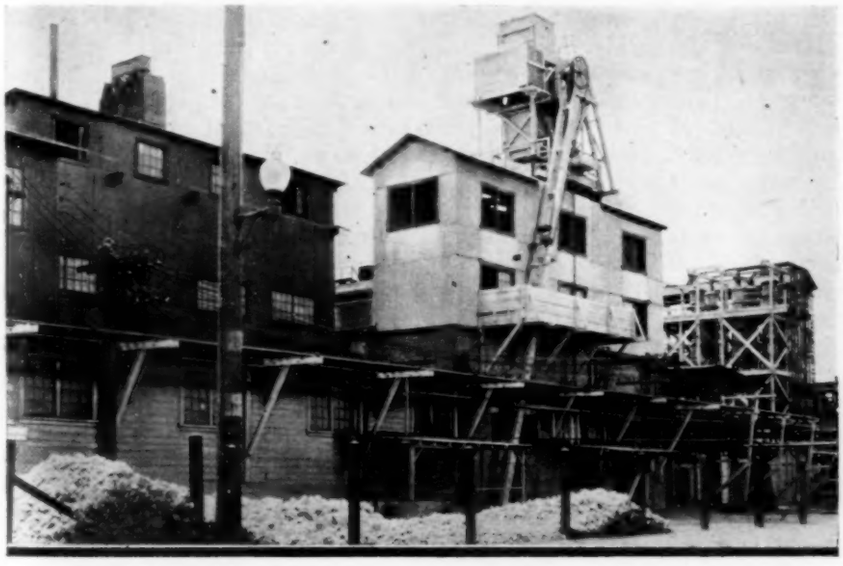
Available chlorine storage consists of four 50-ton units. Shipment is in small cylinders, one-ton containers, and in single-unit tank cars. Each cylinder is cleaned, washed with water, and dried with warm air before it is filled. A freshly conditioned valve is used in each container, and the outsides of the cylinders are repainted. Containers are filled on platform scales.

The bleach plant, built in 1920, has a monthly capacity of 800 tons. It consists of ten concrete chambers, coated with asphalt. The chamber bottoms are brine refrigerated, the brine coils being embedded in the concrete floors. Each chamber is 6 ft. in height, with a base 20x100 ft. A hydrating plant supplies the hydrated lime, which is placed in the chambers to a depth of 3 to 4 in. A mixture consisting of 55 per cent chlorine and 45 per cent air is passed through the chambers counter-currently. One chamber is removed from the circuit every 100 hours. When this is done, the gas is replaced by air, and the reject goes to a new chamber. The hydrator used is the Kreitzer type and has a capacity of 12 tons daily. Refrigeration is supplied by

two De La Vergne units of 120 tons total daily capacity. These machines provide the refrigeration for the manufacture of bleach and xanthates.

Scrap steel from the manufacture of caustic-soda shipping drums goes to the ferric-chloride unit. This scrap is placed in wooden tanks, a small quantity of hydrochloric acid is added to start the reaction and the "snift gases" from the chlorine plant are passed into the tanks until the reaction is complete. The final product, a 50 per cent solution, is marketed mainly in southern California. Its principal use is in sewage disposal, a market which is rapidly increasing.

The present Pacific Coast market for hydrochloric acid is not large; it is supplied in part at a low cost as a byproduct in the manufacture of salt cake. The low price of the acid has necessitated the use of excess hydrogen and chlorine in other ways. However, the acid plant is ready for operation at any time. The process makes use



Portion of the Pittsburg Plant of the Great Western Electro-Chemical Company Showing the Chlorine Drying Towels on the Extreme Right and the Liquid Sulphur Dioxide Department in the Center

of the reaction between chlorine and steam. A stack-like furnace 2x8 ft., lined with acidproof refractories, forms the reaction chamber. Chlorine and steam enter the chamber at the bottom of the furnace and coke is charged in at the top. The net result of the several reactions is given by the equation: $C+2H_2O+2C1_2=4HC1+CO_2$. The acid-containing gases then pass through a dust chamber, are cooled, and the acid is absorbed in a standard Tourill tower system. The motive power for gas flow is a fan at the end of the system. The temperature of the reacting chamber is about 900 deg. C. and, once started by an air blast on the burning coke, operation is self-maintained. The yield is high.

During the war, when creosote prices were at high levels, zinc chloride was used by many railroads in treating ties. This product was produced as a 70-per cent solution by roasting and chlorinizing zinc ores. The plant is kept in a standby condition. Part of its equipment consists of a flotation plant, a 15-ton, six-hearth Herreshoff furnace, and a Cottrell fume precipitator. Capacity in terms of pure zinc chloride is from 12 to 15 tons per day.

A part of the ammonia, together with Anaconda phosphoric acid (50-55 per cent P_2O_5), furnishes the raw materials for the manufacture of diammonium phosphate. This product is sold in 125-lb. bags for fertilizer, and goes mainly to California and Hawaiian markets. It analyzes 22 per cent ammonia and 50 per cent phosphorus pentoxide.

As previously mentioned, in addition to the electrolytic production of caustic soda, it is also manufactured by causticizing soda with lime. This process is unique by reason of the raw materials used. The Great Western Electro-Chemical Company owns the property of the old Inyo Development Company. This company, at Owens Lake, formerly harvested and marketed a crude natural soda consisting of trona and soda ash. (Chapman, *Chem. & Met.* 24, pp. 683-8, 1921.) The Owens Lake property has been leased to the Natural Soda Products Company at Keeler, Calif., which supplies a raw material, a soda concentrate, for the causticizing operation. This material, a 40 per cent Na_2O, is made by calcining the natural material with waste heat and is shipped by rail to the plant.

A saturated water solution containing 250 grams of sodium carbonate per liter is prepared from this crude soda. Solution is accomplished by means of a lixiviator consisting of a 5x20-ft. rotary drum. There are three 10,000-gal. storage tanks for this solution. A small quantity of lime is added to aid the settling, and the liquor is run to settling tanks which furnish the liquor storage. After the liquor is mixed with milk of lime and passed through two thickeners, it goes to three 10,000-gal. causticizing tanks fitted with T agitators. The batch system is used at present, but this is to be replaced by a newly developed continuous system which will completely revise the present operations and will result in a saving of floor space.

Causticizing is carried to 90-91 per cent during one hour, and the liquor is pumped to a 20-ft. Dorr thickener. To facilitate settling, the liquor for causticizing is kept as hot as possible. The nearly clear liquor then passes to a 60-ft. Dorr thickener. The sludge is filtered on an 8x8-ft. Oliver filter, and the filtrate is added to the clear liquor. The sludge is repulped in a trough with water and again filtered on an 8x8-ft. Oliver. The filtrate passes to the soda-dissolving tank and the lime sludge, holding 50 per cent water, goes to a 6x125-ft. rotary lime kiln. A ton of lime is burned per ton of caustic produced. No lime is discarded from the system, as the small mechanical losses are found ample to keep impurities purged from the system. Less than 10 per cent of Sonora lime (U. S. Lime Products Company, Sonora, Calif.) is added for make-up.

Sodium bicarbonate was recovered formerly by using the lime-kiln gas for carbonation, but this is no longer carried out. More water could be removed from the lime sludge, but it has been found that the lime kiln "rings up" when working on a more concentrated pulp and also it is easier to pump this slurry. The hot zone of the kiln is lined with Harbison-Walker refractories, while the other zone is lined with a refractory made in

the plant. The lime is slacked in a 5x20-ft. rotary lime slacker.

The crystal-clear liquor from the large Dorr thickener is pumped to the evaporator house, where it is concentrated in a double-effect circulating type Zaremba evaporator, operating as a batch process. As the causticized liquor contains less salt, no traps are required. The liquor passes from the first to the second effect, then to a settling tank, finally returning to the second effect. When a batch is concentrated to 50 per cent, it goes to a 4x6-ft. Oliver filter and from there to cooling tanks. It then passes to settlers.

Considerable sulphur dioxide is used by the oil industry on the Pacific Coast as the refining agent in the Edeleanu process. The first plant for the production of liquid sulphur dioxide was established by the Associated Oil Company at Avon. This plant was later sold to the Great Western Electro-Chemical Company, which removed it to Pittsburg and greatly improved and enlarged it.

The raw material used is Texas sulphur, shipped by boat to San Francisco, and from there by train to Pittsburg. It is burned in two rotary Glens Falls sulphur burners about 14 ft. long by 18 in. in diameter. The combustion gases, containing about 14 per cent of sulphur dioxide, pass through a cast-iron condenser, where they are cooled by air, and then by water while passing through a lead-pipe cooler. The gases leave the coolers at room temperature and are absorbed in water in a single lead-lined, 3x60-ft. absorption tower. This tower is filled with stoneware Raschig rings. The resulting solution contains 1.2 per cent of sulphur dioxide, which is removed from the solution by passing it through a 12-plate column still about 3x15 ft. There are two of these stills, lined with lead. Heat is supplied by live steam.

Gases from the still pass through a heat exchanger and then into a drying tower. Two of these lead-lined towers, each 12 ft. x 18 in., are available. After the sulphur dioxide is dried by the sulphuric acid it is stored over oil in a gasometer.

Three Borsig-Berlin single-stage piston compressors compress the gas to 50-lb. pressure. Shipment is made in 5-, 10-, 35-, 100-, and 150-lb. cylinders, and in multi-unit tank cars carrying fifteen 1-ton containers, as well as in single-unit tank cars each carrying 15 tons. Most of the liquid SO_2 is sold to the four large oil refineries in central California, but fumigation of grapes, apricots, and the like provides an additional market.

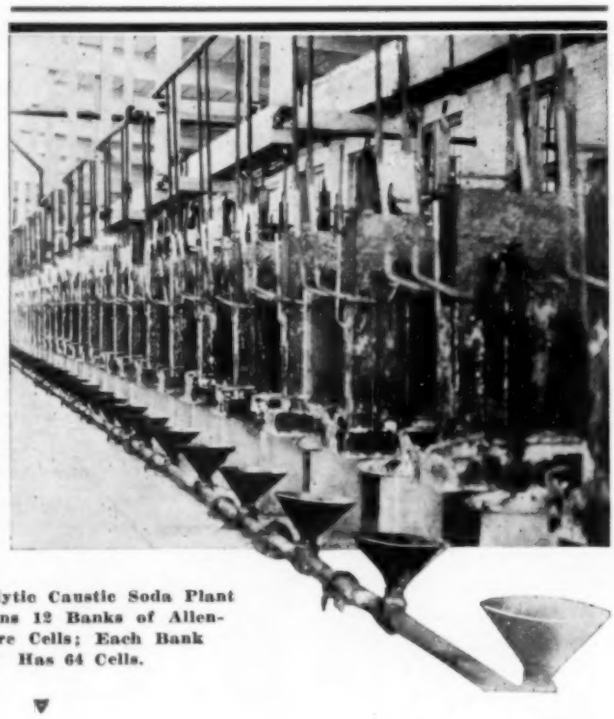
A new process for the manufacture of alkali and alkyl xanthates produces about 90 per cent of these materials consumed in the United States. Caustic alkalis, alcohols, and carbon bisulphide, the more common chemicals made on the Pacific Coast, form the raw materials. This company was the first to produce a stable sodium xanthate commercially. The xanthates are used in flotation work, insecticides, and soil fumigation. The manufacturing process is a dangerous and difficult one, and hazardous from the workers' standpoint. The company goes to great lengths in its efforts to protect its workers. Before entering this part of the plant, each man completely changes his clothes, and the clothes provided are laundered daily.

An interesting service is provided for users of sodium hypochlorite. The apparatus for making the hypochlorite is so small that it has proved cheaper and more advantageous for users to make this material as required. This is especially true with laundries. To such users, the company furnishes technical advice in design, installation, and operation, and supplies the chlorine in cylinders.

Steam required in production is produced in three 600-hp. Babcock & Wilcox Sterling boilers. The boilers are adjacent to the caustic fusion pots and the same operators care for both fires. The whole plant is kept clean and neat and its operation gives the impression of efficiency and pride in production on the part of the workers. A swimming pool is available for use by the workers.

Complementary plant equipment includes machine, electrical shops, etc. An active research laboratory and staff continually develop new products to fill West Coast markets.

We are greatly indebted to J. F. C. Hagens, president; C. W. Schedler, vice-president in charge of operations; and to W. Hirschkind, chief chemist and director of research, for permission to write this article and for their wholehearted co-operation in its preparation.



Electrolytic Caustic Soda Plant Contains 12 Banks of Allen-Moore Cells; Each Bank Has 64 Cells.

Heavy Chemical Technology Features Detroit Sessions

EDITORIAL STAFF REPORT

CHEMICAL engineers have had an unusual opportunity to observe the remarkable advance of Detroit's industries. When the American Institute of Chemical Engineers first met there in 1912, the automobile industry was in its infancy. Nine years later, in 1921, the Institute saw the beginnings of large-scale aircraft manufacture. Returning again, nine years later, June 4 to 6, 1930, the chemical engineers turned their attention to the underlying chemical industries that have contributed so much to the growth of the district. Technical sessions and plant inspections provided the opportunities to study the advances in technology. An enterprising local committee headed by R. A. Plumb, vice-president of the Truscon Steel Company, with Dr. Herbert H. Dow, president, Dow Chemical Company, Midland, Mich., as honorary chairman, provided perfect arrangements for the entertainment and comfort of the several hundred members and guests who attended the convention.

Chemical engineering theory and practice found a happy balance in the technical program, arranged by a committee under the chairmanship of Prof. W. L. Badger. Because of Detroit's importance as a salt- and alkali-producing center, caustic soda received particular attention. Perhaps the outstanding feature of the three technical sessions was the paper on the "Evaporation of Caustic Soda to High Concentrations by Means of Diphenyl Vapor," prepared by W. L. Badger, C. C. Monrad, and H. W. Diamond.

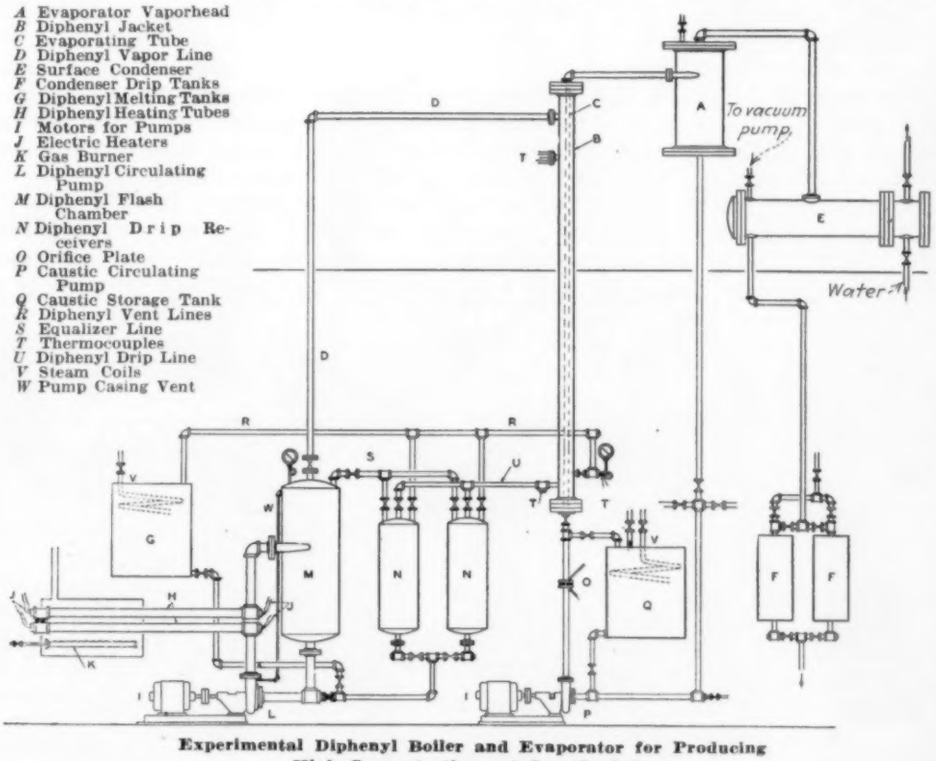
Two important advances in chemical engineering information were indicated. The results first indicate clearly the successful use of diphenyl as a high-temperature heating medium in place of steam or other vapor and, second, convincingly describe conditions under which caustic soda may be carried to much higher concentrations than has hitherto been practicable in any type of evaporator.

The diphenyl boiler used in the experiments was strictly a laboratory affair, because of the limited-scale investigation that was possible. It was, however, of sufficient size to indicate the essential characteristics for jointing and handling of this chemical heat-transfer medium on a larger scale. It was also of sufficient size to show that diphenyl may be used on a large scale with technical success and with heat-transfer characteristics that suggest very interesting possible economies.

The experimental evaporator was made of a size sufficient to study the rates of heat transfer and film coefficients as well as to demonstrate mechanical problems, both in caustic handling and in leak prevention with diphenyl. In regard to the latter, the authors conclude that "it was not found difficult to make an ordinary screwed joint without welding that would hold diphenyl. This was accomplished by coating the threads with a litharge-copper-oxide-glycerine cement." It is noted by these investigators, however, that valves, stuffing boxes, and packing did introduce difficulties. These difficulties, however, were overcome either by such external cooling as to cause some solidification of the diphenyl in the packings where it furnishes a lubricant as well as a seal, or by such modified packings as would permit operation under greater pressures.

Fifty-per cent solutions of commercial flake caustic were used as a starting material in the efficiency and heat-transfer tests. The method of manipulation of the experimental equipment using this solution will be evident from the diagram of evaporator and boiler. Complete thermal analysis of the operation was not possible in the experimental equipment under all conditions, but

A Evaporator Vaporhead
B Diphenyl Jacket
C Evaporating Tube
D Diphenyl Vapor Line
E Surface Condenser
F Condenser Drip Tanks
G Diphenyl Melting Tanks
H Diphenyl Heating Tubes
I Motors for Pumps
J Electric Heaters
K Gas Burner
L Diphenyl Circulating Pump
M Diphenyl Flash Chamber
N Diphenyl Drip Receivers
O Orifice Plate
P Caustic Circulating Pump
Q Caustic Storage Tank
R Diphenyl Vent Lines
S Equalizer Line
T Thermocouples
U Diphenyl Drip Line
V Steam Coils
W Pump Casing Vent



Experimental Diphenyl Boiler and Evaporator for Producing High Concentrations of Caustic Soda

very satisfactory data were obtained for measurement of heat-transfer coefficients. From these data it is concluded that the liquid film coefficient is so high as compared with the diphenyl-vapor film coefficient that the latter controls altogether the rate of heat transfer.

Caustic was concentrated in the evaporator to as high as 98.2 per cent by use of diphenyl pressures up to 150-lb. gage. Even with this high temperature all serious mechanical difficulties were overcome and the practicability of using a tubular evaporator almost up to the point of finished caustic was demonstrated. The authors expressed the opinion that caustic pots probably would still be required for iron removal and finishing under most conditions where a completely anhydrous and high-purity caustic must be made. The indication is, however, that for many conditions caustic can be finished in the evaporator without resort to the customary pot operation. The relative cost of this and the present caustic concentration methods cannot yet be estimated, because of the early stage of the industrial features of this investigation.

Recent advances in both theory and practice of producing caustic soda by causticizing soda ash with lime were reported by W. E. Piper, chemical engineer of the Dorr company, in the paper published elsewhere in this issue of *Chem. & Met.*

J. J. Healy, Jr., chemical engineer for the Merrimac Chemical Company, recited some of his experience with the Cottrell precipitator in the purification of burner gases in a contact sulphuric-acid plant. His paper is published on pages 366-7 of this issue of *Chem. & Met.*

Crosby Field has been responsible for the development of an ingenious machine for the continuous manufacture of ice in the form of small flakes, known by the trade name of "FlakIce." Because of very large surface area per unit weight, this form of ice has many times the *accessible* latent heat effusion of crushed or cake ice. Mr. Field revived interest in earlier attempts to produce ice particles, and several years ago perfected a machine that has reduced the cost of manufacture below that of any other form of ice. It is particularly applicable to the problems of chemical industry where very rapid heat absorption often is necessary.

The principle of the FlakIce machine is the freezing of a layer of ice to a metal surface by absorbing heat through that surface and then causing the shape of the metal surface to change, resulting in a peeling of the ice. This principle is applicable to the flaking of other materials than ice. In the revolving cylinder type of machine which has been developed commercially, the cylinder is of Monel metal, Mond 70, or nickel. The whole is installed in a water tank and as the cylinder rotates around the drum containing the refrigerating brine, the surface collects ice, which is ultimately discharged by the deformation of the cylindrical casing. The flakes are peeled off, float on the water, and are then skimmed from the surface by an automatic conveyor which carries the product to the final storage bin.

DURING the World War, Prof. O. R. Sweeney, head of the chemical engineering department at Iowa State College and at that time a major in the Chemical Warfare Service in charge of the chlorpicrin plant at Edgewood Arsenal, observed that oxygen might be made in considerable quantities from bleaching powder. Apparently the iron of the bleach tanks or iron and manganese occurring as impurities acted as catalysts.

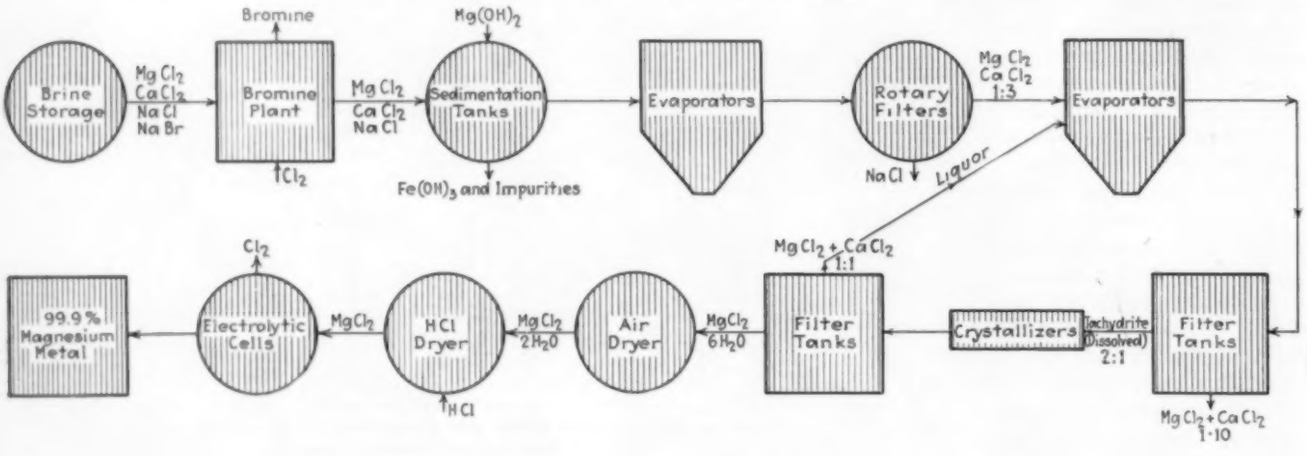
Professor Sweeney, in association with J. W. Hussey, studied this reaction at Ames and their preliminary experiments show a yield of 81.3 per cent of the theoretical merely by heating dry bleaching powder. By passing chlorine over a hot milk of lime suspension, using cobalt nitrate as a catalyst, a yield of 54 per cent of oxygen was obtained. By passing chlorine over lime at 850 deg. C., oxygen was evolved and anhydrous calcium chloride obtained as a byproduct. A study of various cobalt, nickel, manganese, iron, copper, and chromium catalysts showed cobalt and nickel nitrates to be far superior as catalysts.

Sweeney and Hussey have designed a commercial plant in which they estimate that oxygen can be produced at between $7.38 and $15.56 per 1,000 cu.ft. The lower cost estimate is based on chlorine at 2c. per pound; the higher at 4c. In both cases the byproduct calcium chloride is credited at $20 per ton. It was pointed out that while the process could not in general compete with oxygen from liquid air or electrolytic plants, it might find application in industries where slaked lime is a byproduct or where chlorine is available as a waste product.

In discussing this paper, L. D. Vorce, consulting engineer, Montclair, N. J., called attention to the fact that, unfortunately perhaps, chlorine cannot be wasted as such and therefore is not likely to be available for such a process. Prof. R. S. Tour, of the University of Cincinnati, stated that in order to compete commercially, ultimate costs would have to be reduced to the neighborhood of 50 to 75c. per M cu.ft.

Real chemical engineering is involved in the process

Chemical Engineering Processes Involved in Magnesium Metal Production



used by the Dow Chemical Company at Midland, Mich., for the manufacture of metallic magnesium from salt brine. The operations of this plant, now the only commercial producer of magnesium in the United States, were discussed in an authoritative paper by John A. Gann. The process is shown in the accompanying flow sheet. The natural brine, containing approximately 3 per cent $MgCl_2$, 9 per cent $CaCl_2$, 14 per cent NaCl, and 0.1 per cent bromine, is pumped from wells 1,200 to 1,400 ft. deep. After the bromine is removed, the brine is treated with a magnesium hydrate slurry to precipitate iron and other impurities which are separated by sedimentation in continuous thickeners and settling tanks. After evaporation of the decanted liquor, salt is crystallized and removed on rotary filters. The $MgCl_2$ and $CaCl_2$ are separated from each other by a process of fractional crystallization which takes advantage of the fact that the double salt "Tachydrite" ($2\ MgCl_2\ CaCl_2\ 12\ H_2O$) can be separated from liquors much richer in $CaCl_2$. This salt is then reworked to yield $MgCl_2 \cdot 6H_2O$, which is completely dehydrated by heating first in air and then in an atmosphere of HCl.

The anhydrous salt is electrolyzed continuously in large cast-steel pots, in which the pot itself serves as the cathode, while the anode consists of graphite bars. The magnesium metal formed is lighter than the cell bath and therefore rises to the surface and is removed in hand ladles. The average analysis of the metal direct from the cell is 99.9 per cent, arising at times to 99.95 per cent. A cell current efficiency of 75 to 85 per cent is obtained with yields of 1 lb. of magnesium per 8 kw.-hr.

BECAUSE magnesium is but two-thirds as heavy as aluminum, it and its alloys have found important structural applications where extreme lightness and strength are desired. The resistance to chemical attack is of interest to the chemical engineer, particularly its stability against hydrofluoric acid, acid phosphates, chromates, bichromates, and even dilute solutions of chromic acid. In some of these cases a slight attack results in the formation of a protective film that prevents further action.

C. M. Linden and G. H. Montillon, of the University of Minnesota, described work on heat transmission carried out with a small inclined tube evaporator, consisting of one heating tube of 1-in. copper pipe about 4 ft. long, constructed so that the velocity of flow of liquid in the down-take pipe could be measured by an ingenious flow meter consisting of a copper screen bobbin attached to a coil spring that gave deflections which were proportional to the flow of water in pounds per minute. Runs were made with distilled water at 180 deg., 195 deg., and 210 deg. F. and by means of suitable thermocouples, vapor and pipe temperatures were measured at temperature differences varying from 8 to 28 deg. F. for each temperature of evaporation.

From the readings of velocity of flow of water, of vapor and pipe temperatures, and pounds of condensed vapor evaporated, the over-all and individual heat transfer coefficients were calculated. The coefficients on the liquid side were found to increase with the temperature difference at any given temperature of evaporation. The logarithmic mean velocity of circulation of liquid plus vapor also varies with the temperature difference, so that the liquid coefficients bear a definite relation to the velocities of circulation. The over-all coefficients were found to increase with the temperature of evaporation and with the temperature difference.

C. C. Furnas, of the experimental station of the U. S. Bureau of Mines at Minneapolis, discussed another aspect of heat transfer: that from a gas stream to a bed of broken solids. This work, which is a part of the Bureau's study of problems in the operation of blast furnaces, resulted in an entirely new method of calculation by which the author can predict heat changes in many industrial processes.

President A. H. White and Vice-President John C. Olsen
Marshaling the chemical engineering forces that invaded the plant of the Canadian Salt Company at Sandwich, Ont.

Prof. Albert B. Newman, of Cooper Union, presented a paper dealing with the mathematical theory of heat conduction. He has worked out tables and curves from a purely mathematical basis enabling him to predict the time-temperature relationship at any radius of a solid cylinder with a hollow center, provided the thermal properties of the solid and the rate of internal heat input are known. It is shown that the theoretical curves have the same shape as those based on experimental data.

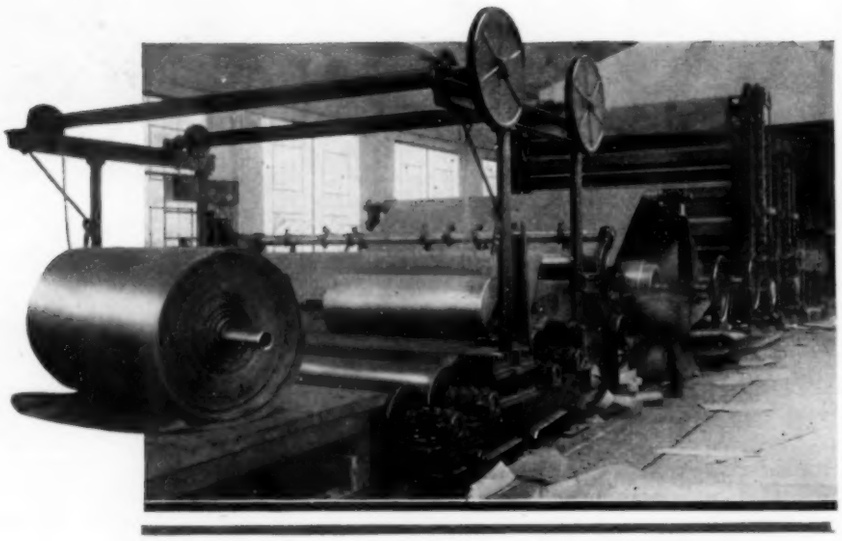
The literature on heat transfer has been singularly silent regarding the transfer of heat from condensing vapors to metal walls. A more thorough search has revealed a paper by Nusselt (*Zeit. V.D.I.* Vol. 60, page 541, 1916) that apparently has escaped the attention of all workers in this field.

C. C. Monrad and W. L. Badger have applied Nusselt's formula to all the experimental work so far attempted. It was found that Nusselt's formula for the condensation of steam on the outside of horizontal tubes is quite accurately checked by experimental results. No correspondence whatsoever was found between Nusselt's formula and experimental results with vertical tubes. The authors attempted to explain this discrepancy by developing a formula to show the conditions under which turbulence occurs in the stagnant film. This apparently will explain the discrepancies qualitatively but not quantitatively. The authors also determined a large number of heat-transfer co-efficients between condensing diphenyl and metal walls. This was done with the vertical tube and gave results about ten times the magnitude called for by Nusselt's formula.

J. W. Schultz, of the University of Michigan, has calculated the latent heats of vaporization of a number of normal paraffin hydrocarbons over a wide range of pressures. The data and curves thus obtained are of value in the design of petroleum distillation equipment which is operated at pressures ranging from sub-atmospheric to 600 lb. or more per square inch.

Extracted Chestnut Chips

MAKING PAPER



Dry End of Paper Machine Showing Rolls of the 0.016 Liner Made of Chestnut and Kraft Pulps

UP TO A FEW YEARS AGO one of the problems of the tannin-extract manufacturer was the disposal of the leached chips. These, until recently, were burned under the boilers. Naturally, because 65 per cent of the weight of leached chips was water, they formed a very uneconomical fuel. Special types of boilers had to be constructed. The economic situation finally compelled these manufacturers to find a means of utilizing this waste material to greater advantage, and resulted in its use as the raw material for making paper products.

Six months ago, the Jno. H. Heald Company, one of the divisions of the Mead Paperboard Corporation, began the manufacture in its Lynchburg (Va.) plant, of 0.016 liner and laminated board of numerous thicknesses, from these extracted chestnut chips. Liner is composed of four layers of chestnut pulp and of unbleached kraft. The laminated board is made of several layers of all chestnut paper together with outer layers of the four to one chestnut-kraft paper. This product is approximately 90 per cent chestnut.

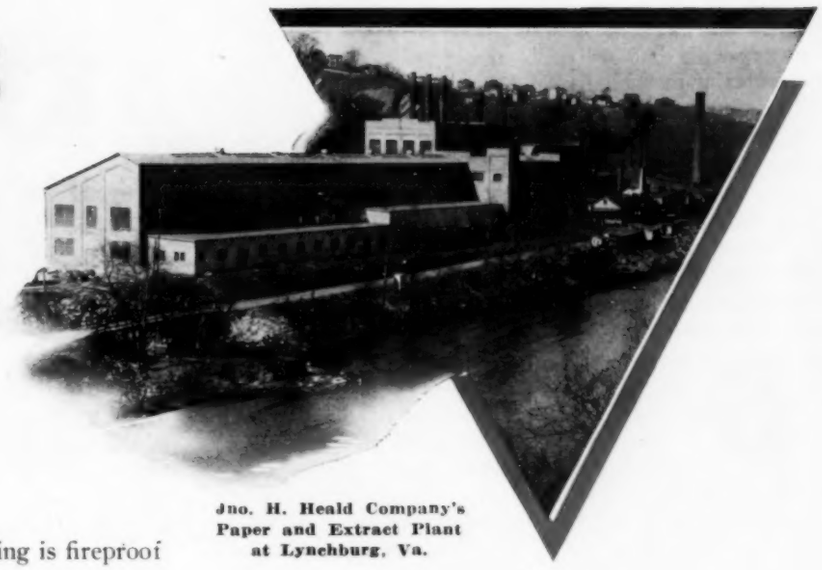
The blight which is spreading rapidly down the Atlantic seaboard has accentuated the necessity for a rapid utilization of chestnut chips, even though the dead wood, for a period of twenty years, can be utilized as readily as green wood, as a raw material for tanning materials and paper making. For many years, this corporation has experimented on chestnut chips development. The Southern Extract Company, one of its affiliated companies, in collaboration with the Forest Products Laboratory, commercialized a process, invented by certain of the employees of the laboratory, for the utilization of spent chips in the manufacture of certain grades of paper and board.

This semi-chemical process for the manufacture of pulp, according to C. E. Curran, W. H. Monsson, and G. H. Chidester (*Paper Trade Journal,* vol. 90, p. 65) consists essentially of the following steps: First, charging of the digester as usual; second, thorough penetration below or at 110 deg. C. with the usual sulphite pulping chemicals; third, a mild cook produced either by lowering the concentration of chemicals, lowering the ratio of chemical to wood, lowering the temperature, pulping for a short time, or any combination of the above; fourth, discharging and thorough washing; fifth, rod-milling the softened chips into individual fibers. The pulp is then ready for the usual paper-making operations.

Heald began the production of tanning materials for tannin extracts in 1869, and originally was the only plant producing this type product in the United States. Today, as 61 years ago, this plant is a leader in the industry, for it still is the largest producer in this country of chestnut, oak bark, and hemlock bark extracts for the use of tanners of leather goods. Next to the historic old buildings now stands the modern installation in which the extracted chestnut chips are converted into paper. The new buildings are models of pulp- and paper-plant construction. The framework is structural steel with brick walls and galvanized steel roof. Sashes

Utilized for PRODUCTS

By JAMES A. LEE
Assistant Editor, Chem. & Met.

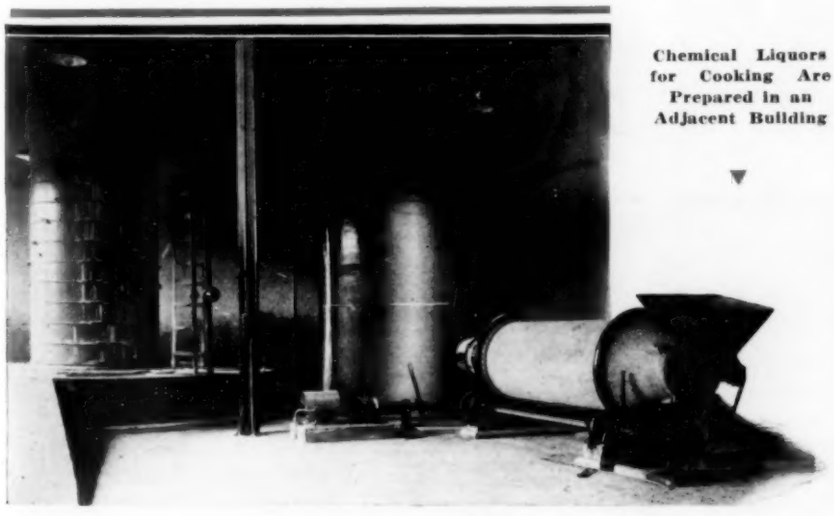


Jno. H. Heald Company's Paper and Extract Plant at Lynchburg, Va.

also are constructed of steel and the building is fireproof in every particular.

The power plant is one of the finest in the state and is equipped with the most modern types of machinery. The main generator is a General Electric 4,375-kva. bleeder type turbine. Motors, magnetic switches, and other electrical appliances were supplied by the Westinghouse company. Electric power is produced from steam generated from pulverized fuel. A Fuller-Lehigh powdered-coal system handles the fuel for the three 1,044-hp. Sterling type boilers, using induced and forced draft with preheated air. Bailey automatic system of controls is used.

The plant is ideally situated as regards both transportation facilities and supplies of wood and barks. Water for use in processing is obtained from a company-owned reservoir fed by springs and situated on a hill above the plant, thus supplying adequate pressure. Two railroads and a river are adjacent to the plant; water from the latter is used in the power house.

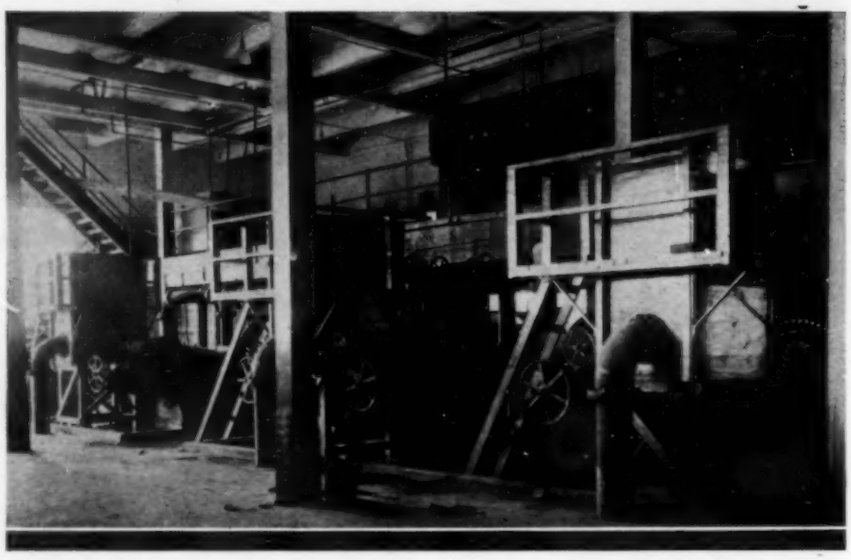


Chemical Liquors for Cooking Are Prepared in an Adjacent Building

In order that the condition of the chestnut chips, when they are received by the paper department, may be clearly understood it will be necessary to go back to the point where the logs are received by the former department and briefly describe their treatment during extracting of the tannin. Chestnut logs receive first a rough chipping in a "hog," and are then threaded in a Jeffries swing-hammer mill, from which they are carried by belt and screw conveyors to the storage bins on the top floor of the extract building. The final size of the chips and the manner in which they are cut is important for the purpose of extracting the tannin and for pulping the leached chips.

An ingenious and unusually efficient device for sampling the chips has been developed by C. R. Oberfell, vice-president of the Heald company. The construction is shown in an accompanying illustration. By this automatic device it is possible to obtain a sample that is representative not only of the large chips but also the dust particles, as the wood falls from one unit to another of the conveying system.

Extraction is done in batteries of seven copper autoclaves connected in series. The capacity of each unit is 2,400 cu.ft. The counter-current system of ex-



Rod Mill Chests Furnish the Supply for the Head Box of the Shartle Jordan

traction with hot water is used; the material in each vessel is in a different stage of the process: the one freshly put in the system receives the liquor containing the largest quantity of tannin while the batch that has been in the system the longest receives fresh water. Therefore, the chips are thoroughly washed before being sent to the paper department. This leaching operation removes practically all of the tannin and a small quantity of other soluble material. The length of the extracting period depends upon the condition of the wood; dry, dead wood does not give up the tannin as readily as does the green wood.

When the extraction is completed the liquor, containing 5 per cent of solids, is forced by compressed air to the storage tanks and later is dried on vacuum-rotary drums during one revolution requiring 7 minutes. As it

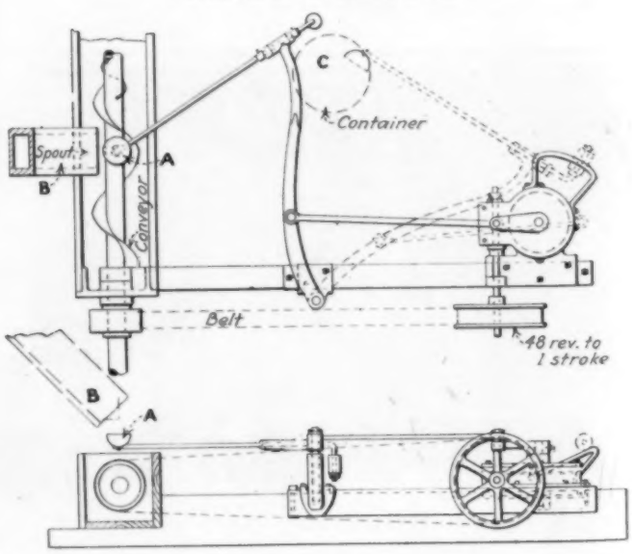
Rod Mills Are Used as the Means for Disintegrating the Partly Digested Chestnut Chips

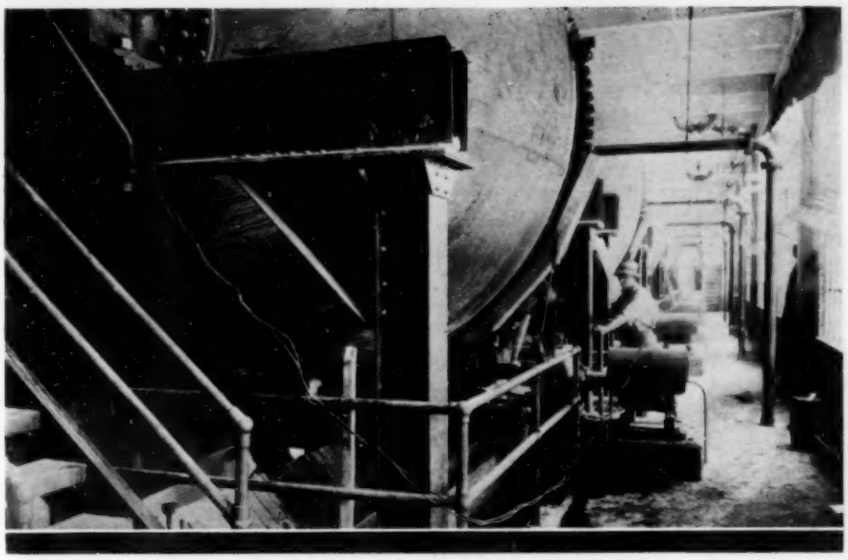
is scraped off the drum by the blade of the dryer it contains 95 per cent solids. After the liquor has been blown out of the autoclave, the bottom is opened and the spent chips, containing 65 per cent water, are carried by a block-and-chain conveyor and bucket conveyor to the storage bins on the third floor of the paper building.

The plant has its own equipment for the preparation of its cooking liquor. Sulphur is burned to the dioxide in the usual manner and passed up through the absorption tower in which it comes in contact with a solution of soda ash. The sulphite liquor falls into the large tank below the tower, and from there it is pumped into the storage tanks located on the digester charging floor.

Openings in the cone-shaped storage bins are directly above the openings in the rotary globe digesters, permitting the easy charging of 2,000 cu.ft. of chips per digester. Steam pressure is applied and the cooking of the chips is conducted in two steps (*Paper Trade Journal*, vol. 83, pp. 50-53). The chips during the first step in the semi-chemical process, become thoroughly impregnated with the chemicals at a pressure of 100 lb. per square inch. The temperature is raised during the impregnation to 120-125 deg. C. and continued until all organic acids are removed. Excess liquor is drained off and returned to storage, where it is strengthened and reused. The temperature and period of cooking are important, in order to obtain the proper degree of softening of the wood. Chips in a weakened though still

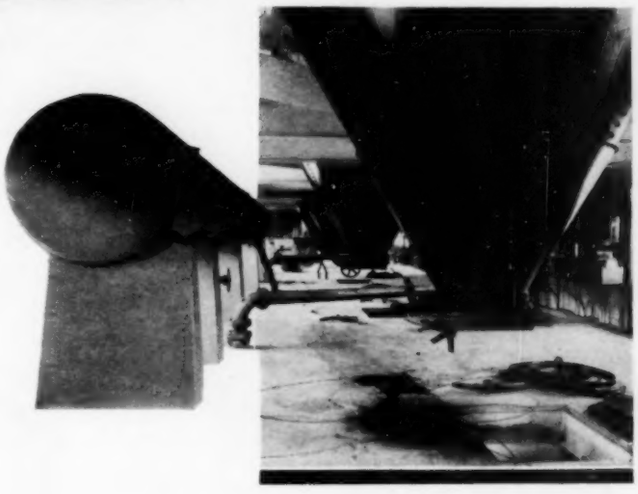
Horizontal and Vertical Drawings of a Unique Device Developed for Sampling Chips





Cooking of the Chips Is in Two Steps in Rotary Globe Digesters. Each Digester Has a Capacity of 2,000 Cu.Ft.

Chemicals From the Storage Tanks on the Left and Extracted Chips From the Cone-Shaped Bins Are Charged Into the Digesters Below Through the Openings in the Floor



rigid mechanical condition are dumped into large wooden pits below, where they are washed by a circular spray of water. A chain and rod conveyor takes them to the Allis-Chalmers rod mills.

Rod mills are used as the means of disintegrating this particular type of material. The 6x12-ft. rod mills at Lynchburg have a capacity of approximately 15 tons per 24 hours, and the process is continuous. Water is added to the pulp in the mills to give the proper dilution, and the pulp then passes through a screw conveyor into the rod-mill chest, which furnishes the supply for the head box of the jordans.

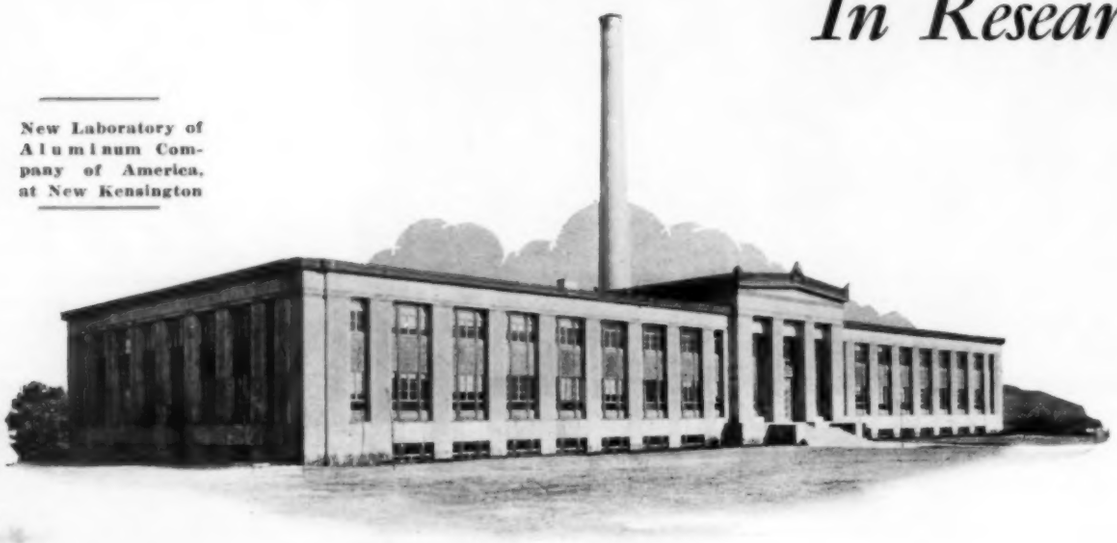
Kraft pulp purchased from outside is processed in Mid West beaters until, as determined by chemical tests, it is sufficiently hydrated, and then passes to the jordans. The kraft pulp sometimes is colored to meet the wishes of the buyer.

A 144-in. Black & Clawson 7-cylinder paper machine, one of the largest of its type in this country, is used for making the paper. Gould fan pumps convey the stock to the vats. This machine has a capacity of 125 tons of paper per day, although in the manufacture of certain grades the capacity can be increased. At the dry end of the machine, the paper is slit, rewound, inspected, and is then ready for shipment. The rolls are carried by a crane to the shipping room adjoining the end of the paper machine, whence it is carried to the cars.

Laminated board is prepared in a room adjoining the paper-machine room, and the equipment is of the customary type. A sufficient number of rolls to manufacture a board of desired thickness are simultaneously passed through the machine, and silicate is used as a pasting material. The layers are pressed together and the silicate is dried as the material passes over the several rolls. As the completed laminated board comes off the end of the machine it is cut into desired sizes. This product is manufactured for use in shipping cases. The board may be produced in numerous thicknesses and used for many purposes, such as panels, shipping cases, and the like.

It is always stimulating to visit a plant where material that was formerly waste is being converted into a salable product. This is particularly true of the plant of the Jno. H. Heald Company, where two entirely different types of products, tannin extracts and paper, are produced. The writer wishes to acknowledge the courteous reception accorded by W. M. Heald, president; and C. R. Oberfell, vice-president.

A Demonstration of Confidence In Research



New Laboratory of Aluminum Company of America, at New Kensington

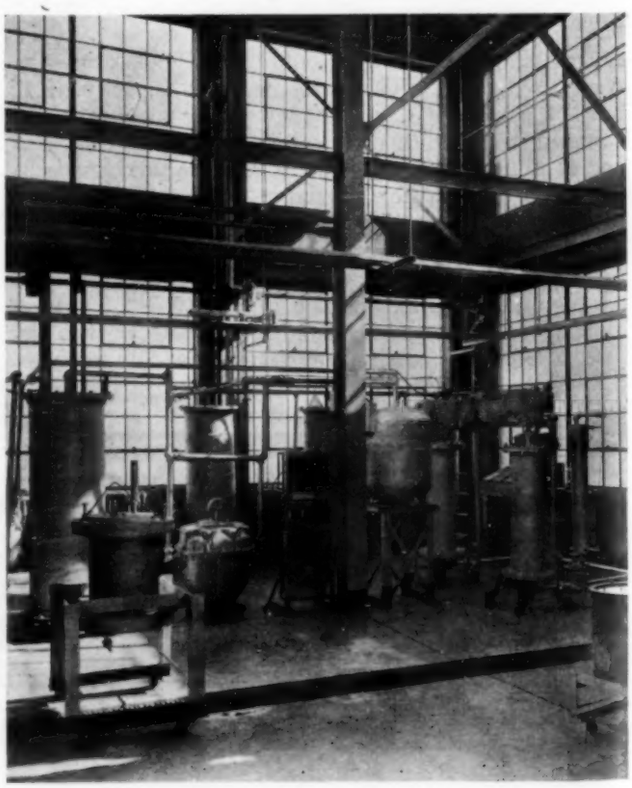
By R. S. McBRIDE
Assistant Editor, Chem. & Met.

CONFIDENCE in the necessity, the permanence, and the profitableness of fundamental research is strikingly demonstrated by the Aluminum Company of America in its new million-dollar central laboratory at New Kensington, Pa. Here it has set up an adequate home, housing both its chemical-engineering and its physical-metallurgy investigations with unexcelled equipment, in an architectural and landscape setting that would be a credit to any public or private agency.

Those who think of this corporation solely as a metallurgical enterprise would not expect to find here the fully equipped chemical-engineering research and development organization which has been installed. Industrial chemicals which are byproducts or derivatives of alumina, paints and lacquers, and a score of other products and processes are receiving the attention of the chemical engineering staff. These activities parallel, and even give promise of outstripping, the present unexcelled facilities established for general chemical investigations, for physical-metallurgical research, and the extensive engineering laboratories for the tests of structural and mechanical-equipment applications of aluminum and its alloys.

In the building itself, a fine architectural work, the company has practiced its own preaching on the use of aluminum. Situated on an eminence in the center of a 14-acre plot, its structural features contribute materially to the prestige of the establishment. On the exterior are cornices, spandrels, window frames, copings, and ornamental trim of aluminum alloys. There also is a most unusual multicolor frieze of cast alloy, on which ornamentation of colored glaze in blues, greens, bronze, and weathered metal effects has been applied. Within the building, hand-wrought oxidized aluminum alloy gates, door grills, and interior ornamentation are likewise in plentiful evidence.

The practical working facilities of the building include extensive light alloy construction of unusual merit. The visitor, of course, recognizes in this the element of promotion of aluminum; but at each point the sound practicability of these applications is equally clear.

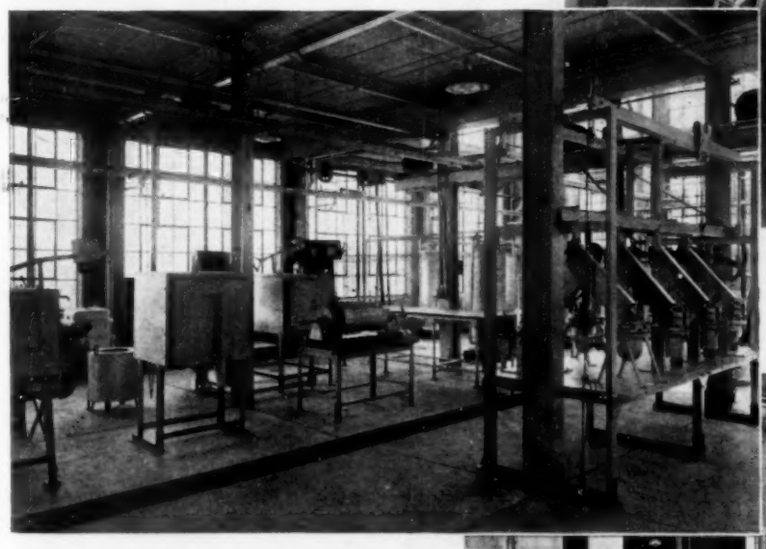


Corrosion resistance, freedom from discoloration in corrosive atmospheres, lightness combined with durability, and other favorable performance characteristics are notable in the furniture and facilities for offices and chemical laboratories, and in the heavier equipment. Even such a heavy engineering facility as a 3-ton crane, which handles samples and machinery in the engineering laboratories for physical testing, is made almost entirely of aluminum "strong alloy" construction.

Several of the advances in application of aluminum alloys are frankly experimental as yet, but most of them seem to be proving both practicable and attractive. Reproduction of these pioneer applications will be facilitated in numerous future laboratories of public, educational, and industrial nature by the fact that commercial equipment builders have co-operated in these first installations at New Kensington. Hence others who desire to imitate this construction will find commercial agencies ready to serve them promptly with a full knowledge of the advantages and limitations of the alloys and with real appreciation of the proper fabrication methods, suitable finishes, and appropriate designs in each case.

The striking nature of the laboratory itself, which was opened first to a group of representatives of the technical and business press on May 20, almost distracts attention from the important work being done by the laboratory. The staff is engaged on a wide variety of fundamental studies for which it is equipped with facilities for physical metallurgy equalling or excelling those of the National Bureau of Standards. All other divisions of the work are equally well staffed and equipped for producing results rivaling the best to be gained anywhere in the several divisions of research which are done.

That a great corporation should thus engage on so large a scale in fundamental studies need indicate no altruistic motive. The research directors of this organization frankly admit that they often have to hazard studies costing from $100,000 up to even $250,000 without any assurance of getting commercially practicable results from the projects. They have, however, been eminently successful in these scientific "gambles"; even in cases where the expected or desired results did not materialize, they have found byproduct values in their studies, or unexpected achievements in the course of their inquiry, amply rewarding the management for its ventures. When one knows of the great success thus achieved it is not a mystery that this company has chosen to place its research organization in such a setting.



Above—Crushing, Grinding, and Sifting Equipment in Chemical Laboratory for Large-Scale Experiments

Above—Laboratory for Large-Scale Chemical Process Development Work

Left—Chemical Engineering Laboratory for Large-Scale Experiment Has Section Two Stories High for Tall Equipment

Right—Metallurgical Laboratory With Furnaces and Rolls for Experimental Production of Aluminum Sheet

New Materials and Methods for GAS MANUFACTURE

EDITORIAL STAFF REPORT
of the Joint Production and
Chemical Conference of
the American Gas Association

INTENSIVE development of manufactured-gas processes, involving critical study of new raw materials and reappraisal of the old, received the thoughtful consideration of 400 engineers and chemists who participated in the joint production and chemical conference of the American Gas Association at Cleveland, May 21 to 23. Approximately 40 technical papers and sub-committee reports were presented under the auspices of the three major committees of the association: water-gas, carbonization, and chemical committees, each of which was responsible for two program sessions. Since this was in fact, as well as in name, a "conference," no association business was transacted. But an unusually important group of discussions filled the well-attended sessions to their time limit.

Competition of natural gas apparently has stimulated even more intensive development of materials and processes for manufactured gas. As a consequence, unusual interest was exhibited in the methods for use of propane and butane, for the use or re-forming of petroleum-refinery still gases, for the more accurate appraisal of coking value of coals, and in the improved types of automatic gas-making equipment. This situation, which has been emphasized editorially on a number of occasions by *Chem. & Met.*, received attention in a half dozen different reports and papers, each with a great interest for the petroleum refiner and chemical engineer as well.

INTERRELATIONSHIPS between the petroleum and the gas industries were made strikingly clear in a paper by H. Janney Nichols, Jr., of the Standard Oil Company of New Jersey. He discussed not only the availability and the inter-industry relation of cracking-still gases and propane and butane but also the important distinctions in business structure of the two branches of the fuel business. He pointed out that the petroleum industry markets its products principally in bulk, and by retail only on a "cash-and-carry" basis. On the other hand, the gas industry is essentially a retail credit business, with intimate relation with individual consumers. For this reason, he emphasized the importance of distributing to ultimate users those gases which are inevitably made as a part of petroleum production and refining through gas-company systems rather than by the creation of a new and duplicating petroleum-industry service.

Cracking units now in operation are a potential source of 900 million gal. per year of propane, equivalent to 85 trillion B.t.u., or to about 30 per cent of the total manufactured gas industry of today; butane is available in equal or greater amounts. Both products within another ten years probably will represent four or five times the heating value of today's manufactured-gas industry. In addition, there are the propane and butane byproducts from natural gasoline, already equal to one and a half times the total manufactured-gas industry; and other unsaturated cracking-still gases swell the available total. On the basis of these facts, Mr. Nichols concludes, "it seems obvious that the gas industry may double, treble, or even quadruple the volume of its business without adding excessively to new investments in the way of plant equipment; may deliver to industry a satisfactory fuel at a price which the gas industry cannot afford today by present methods; and do this at a profit to both the gas and the petroleum industries."

REAL PROGRESS has already been made in utilizing refinery gases, as evidenced by two papers from engineers affiliated with the U.G.I. group. The practical methods for re-forming refinery still gases have been proved out on a large scale and were reported by R. G. Rincliffe, who is superintendent of gas production at Chester, Pa. The twofold purpose of the work described by him included efficient utilization of these gases and the development of a method by which the re-formed gas could be made of a specific gravity suitable for mixing in variable proportions with a coke-oven base-load gas.

Refinery gases, varying from 1,300 to 1,800 B.t.u. per cubic foot and with specific gravity between 0.95 and 1.1, are transmitted at high pressure from refinery to gas works and stored under high pressure for use. When high in hydrogen sulphide the gas is first purified before re-forming, which is a partial cracking operation carried out in a standard water-gas machine. The cycle used on the 9-ft. self-clinkering generator at Chester was quite different from standard practice for carburetting with oil. Using gas, it is not necessary to maintain high carburetor temperature, but the fuel bed must be maintained at a sufficiently high temperature to secure the desired cracking when low-gravity gas is required. The lower the gravity and the lower the heating value desired, the higher must be the fire temperature.

Under the conditions at this works it has not been found necessary accurately to control the heating value of the gas made by re-forming; it appears better to make a re-formed gas of lower heating value than that to be sent out and bring up this first product by admixture of small quantities of additional uncracked rich refinery gas so that the finished mixture is of precisely the desired B.t.u.—520 B.t.u. per cubic foot at Chester.

The results at this plant show that in case of refinery-gas failure the machine can be changed to carburetted water-gas operation on one hour's notice. In operation with refinery gas the consumption of solid fuel and of gas varies according to the choice of the management.

the relative costs of the two raw materials determining whether the one or the other will be used in predominating quantities. Great flexibility of operation is possible, maintenance costs are reported low, and the labor requirement is about that for a corresponding output of oil-carburetted water gas. The flow sheet of the process used at Chester is shown in Fig. 1.

THREE systems are available for using refinery gas, as disclosed by the report of C. A. Schlegel: First, cold enrichment; second, as described for the Chester plant in making gas-carburetted water gas; and third, by making a low-gravity water gas suitable for mixing with coal gas in variable proportions. The relative merit of the three schemes depends materially on the relative cost of refinery gas and of coke. However, cold enrichment can be practiced only when a finished gas of relatively high specific gravity is usable, since the product of this process usually lies between 0.64 and 0.9. And to secure the lower gravity, less of the enricher gas must be used; hence, either the base gas must be of higher B.t.u. or the finished gas send-out will be of lower B.t.u. when low-gravity is a necessity with this process.

When re-formed refinery gas is used for carburetting to a finished gas of 530 B.t.u., Mr. Schlegel indicates that there is a choice in operations between one extreme using, per M cu.ft., 21.3 lb. of coke and 230 cu.ft. of refinery gas as raw materials and the other extreme using 9.2 lb. of coke and 300 cu.ft. of refinery gas. In either case the specific gravity and heating value of the finished gas is the same. If the oil gas is relatively cheaper, then the second scheme obviously is less expensive; but if coke is available at relatively low cost, the first would be the proper choice of conditions. Mr. Schlegel has worked out these relationships in a chart, shown in Fig. 2, to show the relationship of both quantity of refinery gas and the pounds of solid fuel consumed per M to the specific gravity of the finished gas made. By use of this chart it is practicable to determine optimum operating conditions for any given set of economic circumstances.

Butane-air mixtures for city supply have been developed at North Manchester, Ind., by Utilities Service, Inc., and reported to the conference by L. C. Heavner. At this small town an entirely new system was developed to try out the practicability under mid-West conditions of giving such gas service in a community too small to support any of the ordinary sorts of manufactured-gas works. Several months of operating experience indicate to this management that with 300 customers using about 23 M each per year it will be practicable to produce the gas of 550 B.t.u. per cubic foot at approximately 62c. per M of operating expense, with butane at approximately nine cents per gallon.

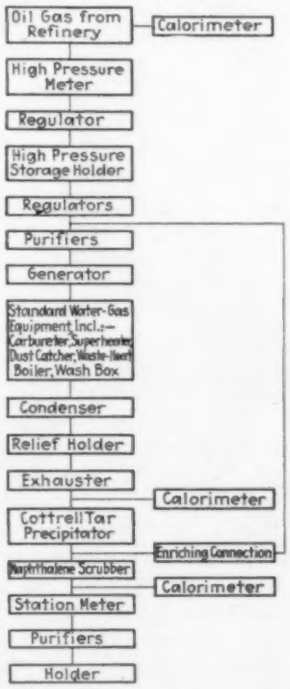
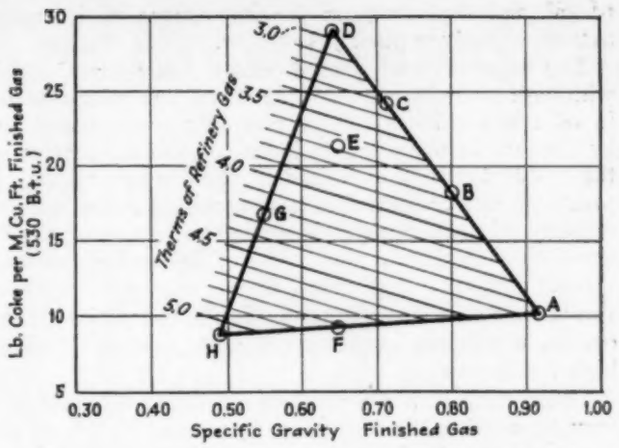


Fig. 1—Flow Sheet of Gas Plant at Chester, Pa., Where Petroleum Gases Are Re-Formed



Gases.....	A	B	C	D	E	F	G	H
Specific gravity...	0.92	0.809	0.715	0.641	0.65	0.65	0.55	0.49
Lb. fuel per MCF.	10.2	18.03	24.19	29.41	21.32	9.22	16.90	8.65
Refinery gas-therms	4.35	3.76	3.31	2.93	3.68	4.82	4.24	5.1

Fig. 2—Schlegel's Chart Correlating Quantity of Refinery Gas and Solid Fuel to Specific Gravity of Finished Gas

Capital charges on the production equipment could be paid at approximately customary rates and a net profit is indicated under these circumstances, according to Mr. Heavner's estimates. Entirely satisfactory utilization equipment is available for use of butane-air gas, according to the experiences of this community.

Carburetting of water gas with oil has also undergone extensive development during the past year. Experiments extended to commercial plant operation in several works were reported by J. V. Richards, of Public Service Electric & Gas Company, to show that this carburetting may be done with full technical success and large operating economy, using low-grade bunker oils instead of the customary types of gas oil. The work reported by Mr. Richards is the accumulation of ten years of investigation, from which it is concluded that "bunker C" grade can be used with great flexibility and very low cost as compared with the higher grades of enricher.

Four concrete examples of actual operating results summarize some of the most important possibilities:

1. Using a maximum of oil to the carburettor on up-run with enough oil to generator on back-run to maintain merely the required finished B.t.u. permits 12.5 M production per make with 25.5 lb. of generator fuel and 3.36 gal. of oil per M. The finished gas has 0.65 specific gravity and 530 B.t.u.

2. Under similar circumstances, but using the blow-run, the results are: 15.1 M made per run with 21.2 lb. of solid fuel and 3.48 gal. of oil per M. The finished gas is of the same heating value but higher specific gravity, 0.71.

3. Using a re-forming process with the oil to the generator split in the ratio of 40 to 60 per cent on up-run and back-run respectively, the make is still further increased per run to 16.5 M, with lower generator-fuel consumption of 18.2 lb. but higher oil consumption of 4.13 gal. The gas is of the same heating value and 0.62 gravity.

4. Combining methods 2 and 3 permits the maximum make of 17.86 M per run, with oil at 4.19 gal. and solid fuel 15.1 lb. per M, and the gravity at 0.67 with unchanged heating value.

The operating engineer has, therefore, wide choice of operating conditions in order to secure lowest over-all costs in accordance with the relative price of coke and

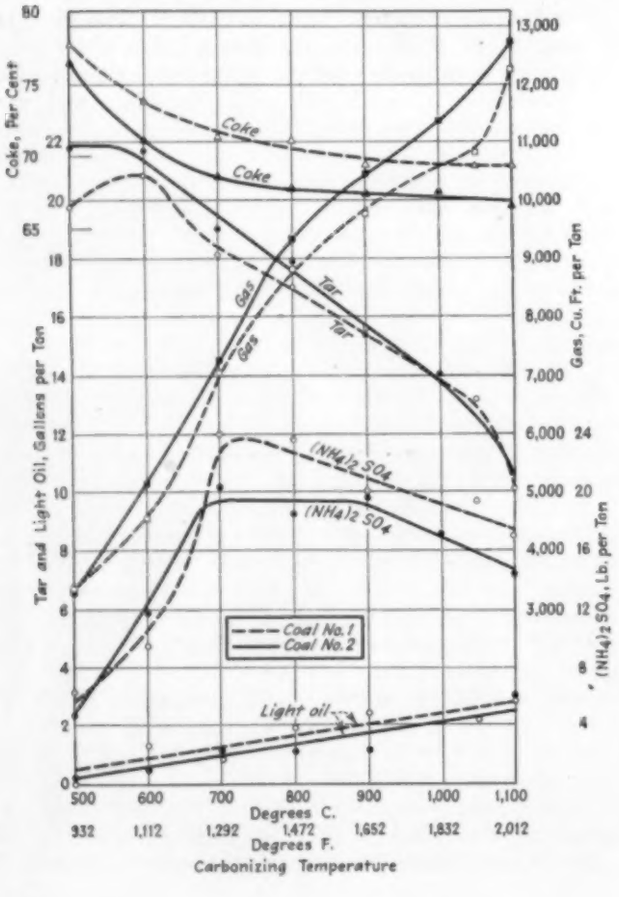
of oil, and dependent on the importance of increased output with given plant investment.

The experience of several plants shows that fuel oil with high viscosity can be handled and that wide changes in oil characteristics can be promptly compensated for by changes in operating technique. Specific gravity of the finished gas, which is important when mixing is practiced, can be controlled within certain limits and the capacity of machines can be varied widely according to need. The residuals produced can be handled without serious difficulty and there is no excessive emulsion formation in the tar separators. Large economies are, of course, obtainable as compared with gas oil of much higher unit cost.

Other results on the cracking of heavy oils and tars were reported to the conference by Gustav Egloff, of the Universal Oil Products Company, Chicago. He pointed out that modern cracking methods can handle almost any hydrocarbon material and that cracking processes are now so flexible that the relative production of different products can be adapted to prevailing economic and market conditions. This means that the distribution of products between gas, gasoline, kerosene, fuel oils, pitch, and coke is more or less within the control of the refiner or cracking-plant operator. As a consequence, the interdependence of gas and petroleum industries has been greatly increased. Many specific examples of results obtainable on a large scale were described and economic and technical considerations affecting them were brought out.

Two systems of oil-gas making recently developed were described at the Conference. L. B. Jones, of San Francisco, reported results which have been obtained at San Diego by the Jones process and explained briefly the economic considerations under which this West Coast development will find application in Eastern territory. One of the outstanding features of the Jones process is that it does not make any lamp black but returns that carbon first produced to the process, obtaining complete gasification of oil. Results were also reported on recent plant operations with the Dayton-Faber process by H. E. Ferguson, of Chicago. This process, by partial combustion of the oil used as raw material, produces a decomposition or cracking in the vapor state to the extent desired, according to the gas needed for distribution. The economic and technical status of this process will be further reported in a later issue of *Chem. & Met.*

Fig. 3—Typical Experimental Yields on Specific Coals Over Wide Temperature Range



EVALUATION of coals and oils for gas making has developed considerably during the last few years. J. E. Brewer of the Chemical Service Laboratories, reported on results obtained with the Mighill method for evaluating gas oil as compared with the practical plant results had from the oils so tested. Data on 29 bargeloads of oil, representing total shipments of about five million gallons, show a close relationship between experimental test appraisal and practical plant results. Nine oils indicated as having an average percentage available for gas enrichment of 68 per cent required 2.99 gal. per M in practical use. The second group, by test appearing 71.8 per cent available, were used with 2.92 gal. consumption per M. The third and best group, by test appearing to be 75.6 per cent available, required only 2.80 gal. per M in the plant. From these facts, Dr. Brewer concludes that although the test may not be of exact quantitative significance in each individual case, it does on the average show a close relationship to the plant performance and permits the selection of oils in accordance with their real operating value.

Three different reports from members of the staff of the U. S. Bureau of Mines dealt with matters of coal testing or the relation between properties and usefulness of coals. A report by A. C. Fieldner indicated that a given coal probably will be favorably affected by washing, provided the washed coal does not contain an excessive quantity of moisture when charged into the oven. The effects of moisture remaining in the coal as charged, are, in fact, the most significant part of this development.

G. St. J. Perrott pointed out that at the present time in coal testing we have standard methods only for a very few of the important properties. He suggested the necessity of adding to the test procedures standard methods for solvent analysis, for measurement of physical properties such as friability and spalling, and for appraisal of agglutinating power, rate of gasification, and other carbonizing properties.

For the first time in its survey of coking and gas-making properties of coals, the Association committee on this subject was able to report experimental data on specific coals over a wide variety of carbonizing conditions. In Fig. 3 may be seen the sort of data being obtained over the temperature range from 500 to 1,100 deg. C. in experimental test procedure. J. D. Davis, in summarizing this report for the Conference, pointed out that the test procedure which is being used in the joint study of A.G.A. and the Bureau of Mines appears to give results on the yields of the principal products which at 1,050 to 1,100 deg. C. correspond with good approximation to commercial plant results on the same coals in both coke ovens and gas retorts.

Electrochemists Are Entertained In St. Louis

Invasion of electrolytic zinc into the retort-zinc district celebrated at spring meeting

EDITORIAL STAFF REPORT

OVER 300 enthusiastic chemists and engineers attended the 57th meeting of the American Electrochemical Society, held at St. Louis, Mo., May 29 to 31. They came primarily to celebrate the invasion of electrolytic zinc into the retort-zinc district. The new electrolytic plant of the Evans-Wallower Zinc Company, at East St. Louis, is the first one to apply fuel-generated electricity to the production of metals from ore. The plant is the largest consumer of electric power in the St. Louis district.

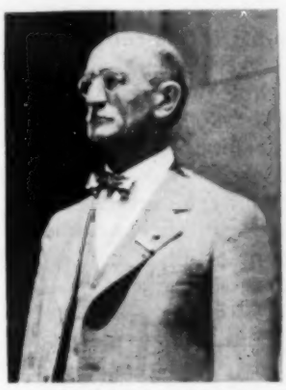
The opening session, Thursday morning, was presided over by Charles L. Mantell, of Pratt Institute. C. T. Thomas and William Blum, of Washington, D. C., described the production of electrolytic iron printing plates at the U. S. Bureau of Engraving and Printing. This is a real "money-making" proposition: Thick printing plates are being made by depositing iron from baths that contain about 3 normal FeC_3, 2 to 4 normal $CaCl_2$, and 0.01 normal HCl. A cathode current density of about 7 amp. per square decimeter is used, and a temperature of about 90 deg. C. Anodes are suspended in porous Alundum diaphragms. The deposited iron has a tensile strength of about 4,000 kg. per square centimeter and an elongation of about 20 per cent. The finished plates are plated with chromium to increase the resistance to abrasion.

Dr. Blum pointed out that the iron deposited is not brittle, as text books would lead one to believe, but are, on the contrary, decidedly ductile. Colin G. Fink, of Columbia University, referred to experiments in his laboratory indicating that iron can be deposited either in the brittle or in the malleable or ductile form, depending upon operating conditions. This, in general, applies to many metals cathodically produced. The softness of the iron deposit of the printing plates makes the final chromium coating all the more essential. Louis Kahlenberg, of the University of Wisconsin, discussed the function of the $CaC1_2$ in the bath described. Aside from increasing the conductivity of the solution its function is not definitely understood.

Secretary Colin G. Fink
Re-elected to post which he has held continuously since 1921

Charles H. Eldridge, of Detroit, referred to the possibility of using lead-alloy lined tanks for chloride solutions; both thallium-lead and silver-lead alloys are serviceable. Francis C. Frary, of the Aluminum company, described tests on agitating ferrous chloride baths, emphasizing that air agitation was found to be practical and efficient, the oxidation of ferrous to ferric being negligible. Others participating in the discussion included Charles A. Styer, of the Westinghouse company; R. L. Seabury, of St. Louis; George A. Perley, Benjamin Miller, and B. H. Jackson.

Robert H. Cherry, of Ridley Park, Pa., submitted measurements on the conductivity of chromium-plating solutions. For all practical purposes, the increase in conductivity of chromic-acid solutions is a linear function of the temperature, over the range of temperatures covered in plating work. Addition of the sulphate ion has the effect of increasing the conductivity of the solution to a maximum when the sulphate ratio is approximately 50, which coincides with the sulphate ratio giving optimum cathode efficiency. The hydrogen and quinhydrone electrodes are definitely shown to give erroneous pH values in chromic-acid solutions. Furthermore, the platinized-platinum oxygen electrode is shown to be inaccurate in chromic-acid solutions. The paper was briefly discussed by Eldridge, Blum, and Abraham Mankowich.



President Louis Kahlenberg
Wisconsin professor newly elected to head electrochemists

Lawrence E. Stout, Oscar G. Burch, and A. S. Langsdorf, of Washington University, laid down the specifications for the electrodeposition of copper-nickel alloys: Alloys of nickel and copper may be plated from baths containing mixtures of their potassium-cyanide complexes. The percentage composition of the deposited alloy depends upon the metal ratio of the bath, upon the cathode current density, and upon the temperature. Increase in the copper content of the bath increases the copper content of the plate, but to a much smaller degree than that indicated by the metal ratio of the bath. The ratio of copper to nickel in the plate increases linearly with the temperature. Low cathode current densities encourage the formation of plates of high copper content. Baths of low free cyanide contents should be used to increase the ratio of deposition.

Commenting on the results obtained, Hogaboom, Sr., said it was a common experience in nickel plating, when two nickel anodes are used in parallel and these were of different anode potential, that copper would deposit

Chairmen of A.E.S. Symposia
Left: T. H. Donahue, of Anaconda Lead Products Company, who presided at discussion on hydroelectrometallurgy. Right: Charles L. Mantell, of Pratt Institutue, who led electrodeposition session.

on one of them. Dr. Fink stated that this was the idea underlying the process developed by Rohrman and himself for the elimination of copper and other metals from nickel-refining solutions. On the basis of their findings, Dr. Fink presented the following general law: When two or more cations tend to co-deposit, due to single potential and/or degree of hydration, the one ion will be deposited in preference to the other or others. Then a lowering of the current density will increase the percentage of that cation in the deposit. This law has been applied to a number of cases and found to hold good each time.

Professor Billiter, of the University of Vienna, communicated his new methods for the electrolytic production of continuous and seamless tubing: In the first method metal is deposited on a short, slightly conical mandrel of chrome or silicon steel (to which the deposit does not adhere), and at regular time intervals the tube is moved slightly forward over the mandrel, thereby exposing a short, bare section of mandrel. During the next time interval a new deposit forms over this bare section and also over the deposit produced during the previous time interval. In the second method a low-melting hollow mandrel (lead) is slowly passed through a plating cell.

Dr. Mantell outlined the new course in industrial education for the electroplating industries given at Pratt Institute. Emphasis is laid on development of practical ability and executive capacity. About one-half the time is spent in the laboratories, shops, and drawing and design rooms. A complete semi-commercial electroplating installation is available for instruction purposes. Furthermore, solutions are analyzed and products are tested. Special study of plating generators and electrical machinery peculiar to the plating industry is included.

The concluding paper of the plating session was on the electrolytic production of turkey-red iron-oxide pigment by Walter H. Bruckner, of Columbia University. There has been an increasingly large demand for a bright red iron-oxide pigment, free from bluish tints. The supply of "blood stone," and other native or natural iron oxides of the turkey-red shade, is rapidly being exhausted. Calcination of copperas is carried out on a commercial scale today, but, although the darker red and bluish-red tints are easily produced, the lighter tints are difficult of attainment, due partly to the high temperature required to decompose the ferrous sulphate. Electrolytic methods for producing turkey-red have been patented. These were investigated. On the basis of a series of experiments carried out under widely varying conditions, it was found that turkey-red free from blue tints can be produced upon electrolyzing sodium-sulphate solutions in a diaphragm cell, using pure iron anodes. Impurities and size of grain greatly affect the shade of the pigment.

Donahue, who was so largely responsible for the splendid array of papers of the symposium on hydroelectrometallurgy, presided. In opening the session he showed how, through the introduction of electrolytic methods and flotation, the metallurgical art of processing ores has undergone important changes during the last 25 years. He then presented a brief review of the status of each of the following metals: copper, zinc, lead, cadmium, silver, bismuth, and nickel. G. A. Roush discussed Donahue's remarks at length. Ralph F. Cohn, of Dixon, Ill., referred briefly to his new method for the removal of bismuth and other metals from lead in which the bismuth content is too low for economical use in the Betts process and too high for use as corroding lead. Metallic calcium is added and the dross formed contains 2 to 5 per cent Bi together with all the As, Sb, Ag, and Au.

IN THE absence of J. J. Fingland, of Trail, B. C., J. J. Mulligan presented the paper on the Betts electrolytic lead process. This is the first detailed account of the process since 1904.

Charles T. Baroch, mill superintendent of the Bagdad Copper Corporation, described the hydrometallurgy of copper at the Bagdad property. The ore minerals are principally chalcopyrite and chalcocite. Copper in the ore averages 1 to 1.25 per cent. After roasting the ore it was leached with spent sulphate electrolyte, resulting in copper extractions as high as 91 per cent. The solution builds up in copper to a concentration of 60 grams per liter and more, the free sulphuric acid dropping to 10 grams per liter. By diverting part of the spent electrolyte into this solution coming from the extraction plant, the copper is brought down to 50 grams per liter and the acid up to 25 grams per liter, resulting in an electrolyte of good electrical conductivity. The current density of the copper cells is 2.1 amp. per square decimeter. Cell voltage has ranged from 1.97 to 2.12 volts.

Frank R. Corwin and Carleton S. Harloff, of Laurel Hill, N. Y., described the recent progress made in the series system of electrolytic copper refining at the Nichols Copper Company. During recent years, the Nichols series system of electrolytic refining has been developed so that improvements made, together with its inherent qualifications, have placed it in a strong competitive position with the multiple system as to quality of production, grade of material handled, cost of production, tie-up of metals in process, and precious metal loss to cathode.

Chief interest in the symposium centered around the zinc papers: U. C. Tainton and Daniel Bosqui, of the Evans-Wallower Zinc Company, described briefly the new plant which the members had inspected the day before. Flotation concentrates are roasted in Wedge furnaces, the roaster gas being converted to sulphuric acid by the contact process. After passing over magnetic separators, the concentrators are leached in spent electrolyte (28 per cent H_2SO_4). The heat of the reaction

raises the temperature to boiling point. Residues containing lead, silver, and gold are shipped to the lead smelter. The leached solution is purified with zinc to precipitate copper, cadmium, cobalt, and nickel. The cadmium is separated from the copper and recovered electrolytically, while the cement copper goes to a copper smelter. In the zinc cells aluminum cathodes are used at a current density of 100 amp. per square feet. Anodes are in grid form, and are composed of a lead alloy containing 1 per cent of silver. During electrolysis, manganese dioxide is precipitated, yielding a high-grade product free from iron, copper, nickel, etc. The electrolytic zinc produced is 99.99 per cent pure. The daily capacity of the plant is 50 tons of electrolytic zinc and 1,000 lb. of cadmium.

Fully realizing the significance of the invasion of the electrolytic zinc process into the district where the retort process held sway for so many years, Frank G. Breyer, consulting engineer, formerly with the New Jersey Zinc Company, came out strongly in defense of the pyrometallurgical processes. He felt that eventually with certain improvements contemplated the old process would regain its lead.

The solubility of zinc in sulphuric acid was discussed by F. W. Harris, of East St. Louis. The rate of dissolution of zinc is expressed in terms of cubic centimeters of hydrogen evolved per minute. The effect of minute additions of impurities is measured, using 99.992 per cent zinc as a base. Of the impurities tested, copper, iron, and antimony have the most pronounced effect, in the order named. Cadmium and lead have only a small effect, and aluminum is practically inert. When small quantities of gelatin are added to the acid, gas evolution is markedly inhibited. Sodium silicate, on the other hand, has only a slightly inhibiting effect.

A NEW impurity of the electrolytic zinc bath that has given trouble is germanium. Tainton and Clayton presented results of their findings: Concentrations as low as 1 mg. per liter of germanium are sufficient to cause serious losses in efficiency. Germanium may be absorbed and removed from solution by means of ferric hydrate precipitated by zinc oxide in the leaching operation. Dr. Kahlenberg was greatly elated over the finding of appreciable quantities of germanium and discoursed briefly on some of the valuable properties of the metal. It was pointed out that it would not be difficult to recover it commercially, according to recent tests.

A paper that aroused much favorable comment was that by Leon R. Westbrook, of the Grasselli Chemical Company, on the recovery of indium from crude zinc liquors, in which it occurs in small amounts. By treating the crude liquors with metallic zinc, indium if present is precipitated out, together with cadmium, lead, tin, antimony, copper, and nickel. Over one pound of the metal was recovered from the residues for experimental purposes. Separation from most of the accompanying elements was accomplished chemically, and the final isolation was by electrodeposition of the metal from a citrate bath, representing the best of several electrolytes investigated. Kahlenberg and Frary suggested a number of valuable applications of the new metal, which is so soft that it can be readily scratched by the finger nail.

The final paper of the symposium was by Fink and Rohrman, on the preparation of pure electrolytic nickel. Separation of copper from nickel has been a difficult procedure, and has been the subject of investigation for many years. Electrochemical methods, using aqueous solutions, were investigated by the authors and the effects of pH and other factors studied. It was found that high acidity, low current density, high temperature, and vigorous circulation favored the deposition and removal of copper. Dr. Glasstone, commenting on these findings, suggested that results be given in terms of diffusion rate and current density. On the basis of his calculated value of diffusion rate and an assumed cathode film thickness, the actual results agree fairly well with the theoretical. J. H. Gillis, of New York, gave an account of his own attempts to remove copper from nickel, using alternating current.

At the business meeting of the society, Edward Dean Adams was elected an honorary member in recognition of his outstanding services in the establishment of the electrochemical industry in America. Final action was taken on changing the name of the society to the Electrochemical Society, effective Jan. 1, 1931. The report of the tellers of election was as follows: president, Louis Kahlenberg; vice-presidents, Bradley Stoughton, of Lehigh; Hugh S. Taylor, of Princeton, and George W. Vinal, of Washington; managers, D. A. Pritchard, of Windsor; M. R. Thompson, of Washington; Alexander Lowy, of Pittsburgh; treasurer, Acheson Smith, Niagara Falls; secretary, Colin G. Fink, Columbia University.

Francis C. Frary chose for the subject of his presidential address research as a vocation. The invited lecturer was George Moore, of the Missouri botanical gardens. His moving pictures of the sex life of plants were very striking.

The social program was in the hands of Carl Hambuechen, local chairman, and ample opportunity was afforded to become personally acquainted with fellow members on the many excursions, at the luncheons, and dances. A particularly well attended session was the luncheon and round-table discussion on water power vs. fuel-generated power for electrochemical industries, in charge of A. S. Langsdorf, of Washington University. "Old King Coal" is rapidly recovering lost ground.

The next meeting of the society will be held at the Hotel Statler, Detroit, on Sept. 25, 26, and 27, 1930. The main session will be devoted to corrosion, and chemists and engineers are invited to participate and submit manuscripts.

Pyrometallurgical vs. Electrolytic Zinc

Left: Frank G. Breyer, consulting engineer, who defended pyrometallurgical processes. Right: U. C. Tainton, whose electrolytic process is used at Evans-Wallower Zinc Company.

R. D. MacLAURIN
Commissioner of Trade Waste,
City of Cleveland, Cleveland, Ohio

Asks another question and answers it

Confusion or Scientific Approach in Chemical Nuisance Control?

NUISANCES arising from industrial operations, manifest both as stream and as atmospheric pollution, are constantly before the legislative bodies of our cities, particularly in the manufacturing East and Middle West. The only type of legislation of a general character in use in America today which attempts to deal with the subject of nuisance under police regulation, is that of zoning. This form of regulation as ordinarily adopted seeks to abate nuisances by the segregation of manufacturing activities in certain districts, outside of which property values are in theory stabilized.

In view of the fact that most chemical engineering operations are capable of producing a nuisance of one sort or another, it seems only logical that chemical producers and engineers should interest themselves in the control of industrial nuisances in general, and particularly that they should view such control from the standpoint of the municipality, for it is only just to admit that chemical works have often provoked legislation which, although unduly onerous, or even confiscatory, has been in part deserved. If industry itself does not insure the scientific approach to nuisance control, it is hardly to be expected that municipal officers, untrained as they ordinarily are in the chemistry of the offending operations, will proceed in a wise and just manner to correct the evils in a way that will be fair to all concerned.

In other words, if industry does not see to it that the way is paved for suitable nuisance control, unjust legislation is practically certain to follow. Zoning is in force in most localities at present, but it is the writer's contention that zoning fails in many instances. Other special legislation has been added to zoning laws before, and this will be done again and again as industrialization becomes increasingly intense.

WHAT is the approach toward nuisance control? England discovered it 55 years ago. In 1875 the Public Health Act was passed, laying the foundation for the Alkali, Etc., Works Regulation Acts of 1881, 1892 and 1906. Although the original act has been twice amended, its underlying theory has remained the same. Provision is made to enforce the use of *the best practicable means* for controlling every nuisance within the scope of the act. What the best practicable means is will, of course, vary from time to time, but the important thing is that the legislation *follows* and does not attempt to *anticipate* the art. It has been amply demonstrated in the 55 years of this regulation that such legislation is enforceable, and at the same time fair both to the public and to the industries affected.

Control of this legislation in England is vested in a Minister of Health, under whom are a chief inspector and a number of under-inspectors whose duty it is to see that the regulations are obeyed. These men, it should be noted, are all highly trained technically, and eminently fitted for the work of conducting investigations and making inspections. Inspectors are appointed by the Minister of Health only after it has been shown that they can have no possible personal interest in the plants or processes with which they are to come in contact.

AFTER appointment inspectors work closely with local sanitary authorities in whom the carrying out of the Public Health Act is vested. The amended act is much too long to reproduce here, but a number of the more significant sections may well be quoted:

"Sec. 1—(1) Every alkali work shall be carried on in such manner as to secure the condensation, to the satisfaction of the chief inspector, of the muriatic acid evolved in such work, to the extent of 95 per centum, and to such an extent that in each cubic foot of air, smoke, or chimney gases escaping from the works into the atmosphere, there is not contained more than one-fifth part of a grain of muriatic acid.

"Sec. 2—(1) In addition to the condensation of muriatic acid as aforesaid, the owner of every alkali work shall use the best practicable means for preventing the escape of noxious or offensive gases by the exit flue of any apparatus used in any process carried on in the work, and for preventing the discharge . . . of such gases into the atmosphere, and for rendering such gases where discharged harmless and inoffensive, subject to the qualification that . . . no objection shall be taken under this section by an inspector to any muriatic acid gas in the air, smoke or gases discharged into the atmosphere . . . where the [concentration] does not exceed the amount limited by the last preceding section.

"Sec. 4—(1) Alkali waste shall not be deposited or discharged without the best practicable means being used for effectually preventing any nuisance arising therefrom.

"Sec. 6—(1) Every sulphuric-acid work . . . shall be carried on in such a manner as to secure the condensation, to the satisfaction of the chief inspector, of the acid gases of sulphur or of sulphur and nitrogen which are evolved in the process of the manufacture of sulphuric acid in that work, to such an extent that the total acidity of those gases in each cubic foot of residual gases after completion of the process, and before admixture with air, smoke or other gases, does not exceed what is equivalent to four grains of sulphuric anhydride.

"Sec. 7—(1) The owner of any work specified in Schedule I [Sulphuric-acid plants, all types; works where mineral phosphates are treated with acids; gas liquor works; nitric-acid works; sulphate- and muriate-of-ammonia works; chlorine works; muriatic-acid works—where made or used; sulphide works; alkali waste works; Venetian red, lead deposit, arsenic and nitrate and chloride of iron works; carbon bisulphide, sulphocyanide, and picric-acid works; paraffin-oil, bisulphite, tar and zinc works] shall use the best practicable means for preventing the escape of noxious or offensive gases . . . into the atmosphere."

Noxious or offensive gases and fumes are defined [Sec. 27—(1)] as including: muriatic, sulphuric, sulphurous and nitric acids; acid-forming oxides of nitrogen; sulphuretted hydrogen; chlorine and its acid compounds, fluorine and cyanogen compounds; carbon bisulphide and sulphur chloride; fumes from cement works; fumes containing copper, lead, antimony, arsenic and zinc or their compounds; and fumes from tar works. The

expression of "best practicable means," used in respect to the prevention of the escape of noxious and offensive gases, is described as having reference not only to the provision and efficient maintenance of appliances adequate for preventing such escape but also to the manner in which such appliances are used.

"Sec. 8—(1) An inspector may inquire whether in any works in which aluminous deposits are treated for . . . making cement . . . or in any works in which sulphide ores . . . are calcined or smelted, means can be adopted at a reasonable expense for preventing the discharge from the furnaces or chimneys of such works, of any noxious or offensive gases . . . (2) Where it appears to the [Minister of Health] that such means can be adopted as a reasonable expense [he] may by order require the owners of the works to adopt the best practicable means for the purpose, and may . . . limit the proportion . . . of any noxious or offensive gas which is permitted to escape from such works . . . into the atmosphere . . . "

In connection with each provision of the regulations certain maximum fines are specified for first and subsequent violations. The act then goes on to make mandatory the registration of all works falling in the groups outlined above, and provides that the registration must be renewed from time to time upon the owner's showing that the plant conforms to the best practical means as then recognized by the Minister of Health. Later sections designate the methods of appointment of inspectors and their duties and provide for the fining of offenders. "Sec. 17—(1) Every such fine shall be recovered by action in the county court having jurisdiction in the district in which the offense is alleged to have been committed." Further, Sec. 23—(1) provides that "Where a nuisance arising from the discharge of any noxious or offensive gas or gases is wholly or partially caused by the acts or defaults . . . of the owners of several works to which any of these provisions of this act applies, any person injured by such nuisances may proceed against any one or more of such owners, and may recover damages from each owner made a defendant in proportion to the extent of the contribution of that defendant to the nuisance, notwithstanding that the act or default of that defendant would not separately have caused a nuisance; [provided, however, that] (2) This section shall not authorize the recovery of damages from any defendant who can produce a certificate from the chief inspector [that the requirements of this act were properly met at the time the nuisance arose]."

This, substantially, outlines the Alkali, Etc., Works Regulation Act, a piece of legislation which places the control of industrial nuisances into the hands of technically trained men and puts upon them the burden of proof that the best practicable means are not being used.

FROM the English system, we turn to a recent series of events in Cleveland, which exemplifies the confusion and chaos that result inevitably from legislation seeking, without scientific basis of fact, to control nuisances arising from chemical operations. For the past five years the district of Cleveland in which the plant of the Industrial Rayon Corporation is located has been in a constant uproar over the hydrogen sulphide-containing gases given off by the rayon manufacturing operations. The writer pointed out some years ago that general opinion is in agreement that a tall stack for dispersing the gases into the upper air currents is the best practicable method. This is the means generally used at other viscose plants and has met with very few objections from inhabitants of the surrounding territories.

Without recourse to the scientific approach, however, the Cleveland City Council passed, in October, 1929, what was known as the Petrash ordinance. This ruling provided for the prevention of emission of "noxious hydrogen-sulphide fumes in the manufacture of rayon" by demanding that "no building . . . [should] be erected, occupied or used . . . within the limits of the City of Cleveland, for the . . . manufacture of rayon, unless such building [was] equipped with such device or process as [would] . . . at any and all times prevent the emission of noxious hydrogen sulphide fumes or other noxious odors . . . into the atmosphere adjacent to such building . . . "

This ordinance may appear fairly innocuous upon the surface, but a little reflection will show it to be confiscatory. In the first place, it required 100 per cent efficiency of H_2S removal at *all* times; and secondly, it prohibited the use of the best practical means: i.e., a fume stack, because such a stack would naturally have to discharge the gases adjacent to the property. Obviously, the ordinance was misnamed. It should have read "To prohibit the manufacture of rayon within the limits of the City of Cleveland." What the ordinance required was unquestionably a physical impossibility.

MEANWHILE, a zoning ordinance was adopted by popular vote, early in November. The beauty of this new ordinance becomes apparent when it is discovered that it grants an unconditional permit for plants not conforming with the requirements of the district in which they are located to continue operations as in the past, provided only that the plant's non-conforming buildings existed at the time of enactment of the ordinance. It becomes apparent that the Petrash ordinance bans what the later zoning law permits. Rayon manufacture is, in effect, prohibited by the former and permitted by the latter.

Such an anomalous state of affairs could not, of course, fail to result in court action. The Rayon corporation started proceedings which, early in February, 1930, resulted in an injunction preventing the city from enforcing the Petrash ordinance. This was followed in May by the company's agreeing to erect a tall fume stack, thus finally ending five years of acrimonious quibbling.

It seems obvious that zoning will not be the ultimate solution to our industrial nuisance problems. Zoning ignores property rights. Residents of districts contiguous to industrial areas reside where they do at their own risk. Zoning ignores common-law rights and as such will eventually, in the writer's opinion, be declared unconstitutional. Instead of zoning, we must have legislation which will follow the development of the art and not attempt to precede it. Legislation in somewhat the following form is suggested as much to be desired:

"A permit shall be required for the conduct of each and every business or manufacturing operation which results in the emission of dust, fumes, odors, noxious gases, or offensive water-carried wastes, and no such business or manufacturing operation shall be permitted to be carried on unless the permit hereby required shall have first been obtained. A permit shall be issued provided each and every business or manufacturing operation shall be so conducted, and shall employ the best practicable means known to the art for the abatement and elimination of dust, fumes, odors, noxious gases, or offensive water-carried wastes; and such conditions of the business or manufacturing operation must be evidenced by the written approval of the Commissioner of Health.

"When adequate means for the abatement or elimination of dust, fumes, odors, noxious gases, or offensive water-carried wastes are not known to the art, it shall be the duty of the manufacturers conducting such operations to investigate and provide ways and means for abatement in co-operation with the authorized officials of a municipal corporation; and for the conduct of each and every such business or manufacturing operation, a temporary permit may be issued."

Such legislation, the writer submits, is best adapted to control nuisances of manufacturing origin. It can be enforced and yet, at the same time, the property rights of both public and manufacturer will be protected.

CAUSTICIZING

Benefits From Improved Theory and Practice

By W. E. PIPER
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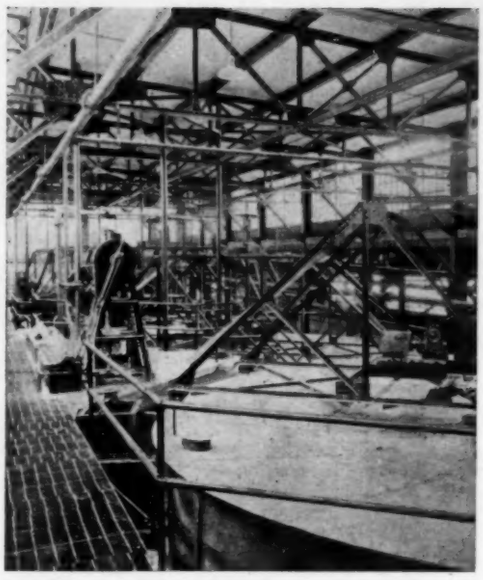


Fig. 1—Continuous Thickeners for Green Liquor Clarification and Lime Mud Washing in the Plant of Union Bag & Paper Power Company, Tacoma, Wash.

IN ACCEPTING the 1930 Perkin medal of the American Chemical Society, Herbert Dow made the following statement which suggested this paper and may well serve as its thesis:

"The chemical reactions involved in the Solvay process . . . are today practically identical with those of 50 years ago, but the present equipment for carrying out these reactions differs enormously from that of the early period. The immediate developments before us point more and more toward the installation of continuous processing wherever possible."

This paper will deal with studies relating to the influence of certain physical and chemical factors in causticizing practice, and in it there will be discussed some recent work, resulting in the development of flow sheets of an advanced type for carrying on causticizing and its incidental operations on a continuous basis.

Discussion which follows will be in no sense limited to practice in the alkali industry but will include practice in other industries, notably the chemical pulp industry, where recausticizing is a most important operation and where practice has advanced rapidly during the last five years.

At the risk of its appearing unduly elementary, but for the purpose of introducing the discussion to follow, the objectives of recausticizing and its technical and economic limitations will be touched upon briefly: The objectives include: (1) The highest possible conversion of sodium carbonate to sodium hydroxide, consistent with solution strength and quantity of CaO economically available; (2) clearest possible solution of caustic soda; and (3) greatest possible recovery of caustic soda from the calcium carbonate sludge, consistent with the quantity of weak wash solution which subsequently may be reintroduced into the process cycle.

From the technical and economic standpoints, certain limitations appear:

1. Conversion or causticity bears a given relationship to the strength of the sodium carbonate solution to be causticized; the greater the strength of the solution, the less the conversion and vice versa.

2. The degree of clarification of caustic soda solutions depends upon the time of settlement (in batch decantation practice) and upon settling area provided (in continuous decantation practice). The rate of settlement of precipitate bears a given relationship to particle size, temperature and strength of solution; the coarser the crystals, the higher the temperature and the lower the solution strength, the more rapid the settling rate and vice versa.

3. Efficiency of washing the precipitate free from caustic soda is a direct function of the quantity of wash water available and usable subsequently in the process cycle, and of the density to which the precipitate will settle. The greater the amount of wash water available and the greater the maximum sludge density, the greater is the washing efficiency.

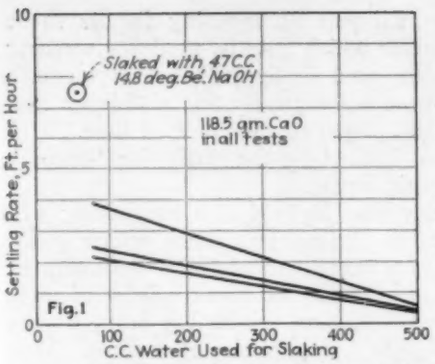
4. Reaction rate, all other factors being the same, is influenced by the excess lime used, over and above that theoretically required for completing the reaction; the larger the excess of lime the more rapid the reaction, and vice versa.

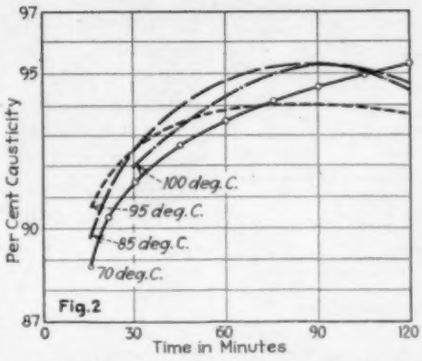
With this background it is now possible to consider the process cycle in a causticizing plant which may be resolved into a number of unit operations, connected together in sequence, each one of which performs a definite processing objective. In their order of sequence these are: (1) Lime slaking, (2) causticizing, (3) caustic liquor decantation, and (4) lime mud washing.

Research studies, later confirmed on a commercial scale, have shown that certain physical conditions, if carefully maintained at the optimum point, have a very appreciable effect on the chemical results subsequently obtained, and also on the mechanical separation of the caustic solution from the precipitated lime mud by displacement washes. These controllable factors, as brought out hereinafter, affect virtually all of the unit operations enumerated above.

Lime Slaking—The U. S. Bureau of Standards has specified that quicklime for use in causticizing shall contain not less than 70 per cent of available CaO and not more than 3 per cent of magnesia. While the chemical composition of the quicklime is of importance, it also is

Modified slightly from a paper presented by the author under the title of "Recent Advances in Causticizing Theory and Practice" before the June, 1930, meeting of the American Institute of Chemical Engineers in Detroit, Mich.





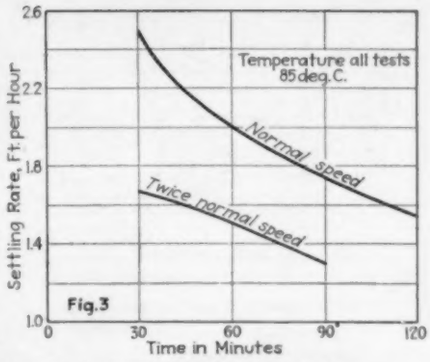


Fig. 2—Curves at Left Show Effect of Dilution During Slaking on Rate of Settlement; All Tests Had 3 Per Cent Excess Lime and All Slurries Were Diluted to Same Consistency Before Adding Na_2CO_3 Solution. Fig. 3—Curves at Center Show Effect of Temperature and Reaction Time on Causticizing. Fig. 4—Curves at Right Show Effect of Speed and Duration of Agitation During Causticizing on Settlement Rate

of importance how the quicklime is slaked, since experience has shown that the particle size of the hydrate persists through the recausticizing stage, thus exerting great influence on the facility with which the caustic liquor and precipitate may later be separated by decantation.

Milk of lime prepared by slaking the lime with all the water available yields, after causticizing, an extremely finely divided, dispersed precipitate which settles at a very low rate; 0.16, 0.19 and 0.28 ft. per hour in three cases observed. When the above procedure was modified slightly, through slaking in just enough water to produce the dry hydrate and then repulping the hydrate with the balance of the water before recausticizing, the settling rate of the resulting calcium carbonate precipitate was accelerated to 1.41, 4.06 and 1.48 ft. per hour in three cases observed. Finally, by slaking in a rotary drum to the dry hydrate, using weak caustic solution, and then repulping with weak caustic, the settling rate of the precipitate was increased enormously to 7.81 ft. per hour. These results are shown graphically in Fig. 2.

From a mechanical handling standpoint, grit and other impurities in the quicklime are objectionable to a certain extent in intermittent, non-mechanical plants and to a very great extent in continuous, mechanical plants, where grit lodges in pipes and valves and causes excessive wear.

The conclusions drawn from these studies were that the preparation of milk of lime should proceed in three stages: first, hydration of quicklime with the theoretical amount of weak liquor; second, repulping with the balance of the weak liquor to a free settling suspension; and third, removal of grit, sand, and unburned core by selective sedimentation (classification).

Causticizing—It has generally been believed that the higher the temperature during causticizing, the more rapid the rate of reaction and the greater the conversion. Our studies of the effect of temperature (See Fig. 3) indicate virtually no difference in the rate or degree of completion of the reaction with temperatures in excess of 85 deg. C. On the other hand, over the range of temperatures observed, 70 to 100 deg. C., it was found as anticipated, that each increase in temperature was accompanied by an increase in the rate of settlement of the precipitate, a condition of importance in the decantation step, if not in causticizing.

Long and violent agitation during causticizing appears to be detrimental to subsequent decantation, presumably due to floc destruction and mechanical comminution of the suspended solids. Moreover, conversion was not benefited to the extent supposed. For example, at normal agitator peripheral speeds, periods of 30, 60, 90, and 120 minutes of agitation yielded causticities ranging upward from 94.7 to 95.3 per cent, and settling rates ranging downward from 2.50 to 1.56 ft. per hour.

By doubling the peripheral speed, the causticities at the same 30-minute intervals ranged upward from 95.0 to 95.9 per cent and the settling rates ranged downward from 1.67 to 1.25 ft. per hour. These effects on settling rates are shown in Fig. 4.

Conclusions drawn from this work were that temperatures in excess of 85 deg. C. had little or no effect on the rate or degree of the causticizing reaction, although they were beneficial to a slight degree in the subsequent decantation. At the same time deceleration of the settling rate of the calcium carbonate precipitate, caused by prolonged and violent agitation, counterbalanced any slight gains in conversion which would result.

Strong Liquor Decantation—The rate at which strong liquor may be decanted is a direct function of the rate of settlement of the calcium carbonate precipitate in the solution, which in turn is dependent upon the physical character (granular or colloidal) of the precipitate and the difference between its specific gravity and that of the solution. The quantity, of liquor which may be decanted from a given tank, all other conditions remaining the same, is determined by the compactness or density to which the precipitate will settle.

As has been indicated in the discussions of the unit operations which precede decantation, rapid settlement of the precipitate to a dense compact sludge is influenced by a variety of controllable facts, to wit: (1) slaking of quicklime with the amount of weak liquor required to form hydrate, followed by repulping with the balance, (2) causticizing at an elevated temperature, not less than 85 deg. C., in the minimum time and the least violence of agitation consistent with good conversion. The observance of these precautions seemingly causes the lime hydrate to be formed in a relatively granular form which persists throughout the causticizing reaction. This appears to be due to the reaction taking place on the surface of the hydrate, with a gradual replacement of the hydrate by the carbonate by diffusion in the particle rather than by reprecipitation from solution.

Lime Mud Washing—It is common knowledge that it is much easier to remove soluble salts with a given number of washes of given volume from a granular substance than from a colloidal one, and this is strikingly true in causticizing practice. Accordingly, the same controllable factors, beneficial to liquor decantation, are also beneficial in lime mud washing, whether the washing is conducted in intermittent or continuous thickeners or on vacuum filters.

It becomes obvious from the foregoing discussion

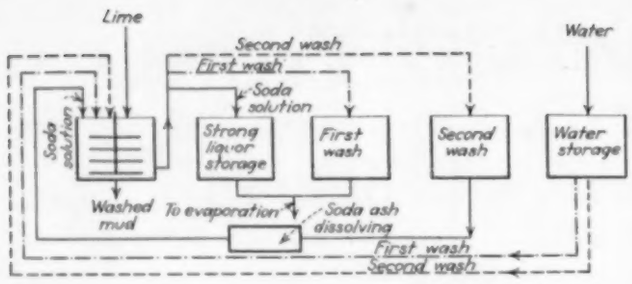


Fig. 5—Early Type of Batch Layout of Causticizing Equipment

This represents probably the simplest type of causticizing arrangement with burned lime and soda-ash solution agitated in a steel tank, equipped with a draw-off connection for decanting the strong solution and subsequent weak washes. The first decantation yields a very strong caustic soda solution of low causticity (low per cent conversion). The mud is repulped with the first wash, which, after decantation, yields a weaker caustic soda solution of higher causticity (higher per cent conversion). The strong liquor and liquor from the first mud washing are both sent to storage ahead of the evaporators or subsequent process. The second water wash yields a very weak caustic soda solution which is generally used for dissolving soda ash. The mud is discharged from the system after the second water wash, with or without final dewatering or, possibly, washing on a vacuum filter. An improvement over this layout is one in which the burned lime is placed in a perforated cage, suspended within the tank, and solution is decanted from the top down by a swing siphon.

that various opposing factors must be reconciled in properly carrying out the causticizing operations. The first of these is the reconciliation of percentage conversion and solution strength. Maximum strength of finished liquor being established by subsequent process requirements or the unit costs of evaporation at about 10-15 per cent NaOH, conversion or causticity (per cent conversion) may be most economically forced to the maximum by two stages of short-period reaction, separated by an intermediate stage of decantation and repulping of the mud with weak liquor.

Both reactions are carried out at an elevated temperature—not less than 85 deg. C. In the primary stage of reaction, the rate of conversion in strong sodium carbonate solution is forced by the use of a heavy excess of lime. In the secondary stage, the free-lime-bearing mud is repulped with weak liquor and treated with sufficient additional sodium carbonate liquor to react with the free lime. The intermediate stage of decantation between the two stages of agitation yields a strong finished liquor of high causticity. The first washing stage of decantation following the second stage of agitation yields a weak caustic liquor, which re-enters the system as make-up solution for soda-ash dissolving and lime slaking.

Second of the opposing pairs of factors which must be reconciled is the relation of clarity of finished liquor to the size of the decantation tank. A given clarity of finished liquor having been established, the rate of settlement in the decantation step is a function of the specific gravities of solution and solids, both of which are constant, and of the temperature of solution and the particle size, both of which are controllable. Maximum settling rate may be obtained in three ways: (1) by forming coarse crystals of calcium hydrate by slaking the lime in the theoretical amount of weak liquor; (2) by agitating at a speed and for a period of time which will not destroy the coarse crystalline form of the calcium carbonate produced; and (3) by thoroughly insulating the decantation tank against heat loss. Uniform liquor gravity of the tank contents and the absence of convection currents thus assured have proved highly conducive to rapid settlement and consequently permit the use of small equipment units.

Washing efficiency versus the quantity of wash water permissible is the final pair of opposing factors to be reconciled. The water which may be used for washing the precipitated lime mud is limited to that quantity which may be re-used subsequently for dissolving new sodium carbonate and preparing new milk of lime. This quantity, in turn, is limited by the established strength of the finished caustic liquor.

Washing efficiency may be held at a maximum: (1) by producing a rapid-settling precipitate which yields a dense, low moisture sludge containing a minimum of solubles; and (2) by utilizing the given volume of wash water and the weak solutions originating from its use to subject the sludge to a multiplicity of washes. Multiple washing may most efficiency be practiced by the countercurrent flow of solids and wash liquor, the solids in process of impoverishment being repulped with, and settled from, progressively weaker solutions and, finally, water. The wash solution, in its progress toward the head end of the plant, comes in contact with sludges containing progressively greater quantities of NaOH.

Recausticizing Flow-Sheet Development

A brief review of recausticizing flow sheets, arranged in chronological order, may serve conveniently to illustrate the progress made by chemical engineers in their search for a more and more effective solution of the problems incidental to recausticizing practice. These flow sheets may be subdivided into two main groups: batch or intermittent operation, shown in Figs. 5 and 6, and continuous operation, shown in Figs. 7, 8, and 9. The first group includes two simple arrangements for recausticizing, the first, one of the earliest types of combined causticizer and decanter and a more recent arrangement in which causticizing and decantation take place in individual tanks.

The second group (Figs. 7, 8, and 9) shows three steps in the development of flow sheets for continuous causticizing. They are similar in that all provide for continuous lime slaking in rotary slakers in open circuit with mechanical classifiers; continuous series causticizing in steam-heated, insulated reaction agitators; continuous strong liquor decantation and lime mud washing in a series of insulated, mechanically operated thickeners; and finally, continuous lime mud dewatering (and in Fig. 9 lime mud washing) on rotary vacuum filters. These flow sheets differ as is explained in the captions.

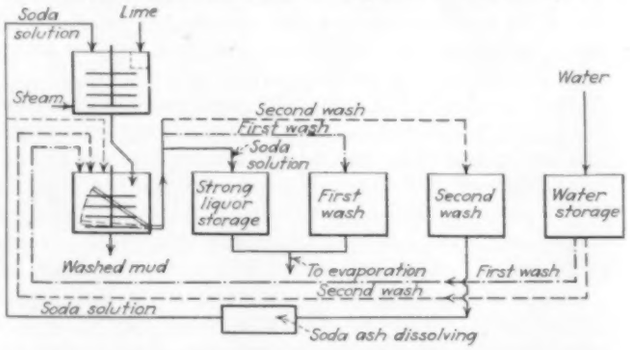


Fig. 6—More Recent Batch Causticizing Arrangement With Separate Tanks for Reaction and Settling

This arrangement provides for causticizing in separate tanks, fitted with agitators, steam jets and lime cages and for decantation and washing in covered tanks provided with swing siphons. The dotted lines indicate a sodium carbonate bypass so that double causticizing may be practiced in order to secure higher than normal conversion or causticity. The reaction in the causticizer takes place in the presence of an excess of lime, thus forcing the utilization of sodium carbonate in a short time. The batch is then dropped into the decanter, the strong liquor is siphoned off, and the settled mud re-agitated with the first water wash and additional sodium carbonate liquor to react with the excess lime. The lime mud is subjected to several water washes in the usual manner.

Let us consider the various stages of treatment in a plant employing flow sheet 9, producing 100 tons of NaOH per day in the form of 12 per cent caustic soda solution. For our purposes, we may consider that a 12 per cent caustic solution corresponds roughly to 15-18 deg. Bé., depending on temperature and causticity. This output is equivalent to 122 g.p.m. of water, including water of reaction; 145 tons per day of sodium carbonate; 74 tons per day of burned lime; and 129 tons per day of calcium carbonate residue (not including about 4 tons of grit, sand, and core removed from the milk of lime by classification).

Water available for washing purposes, 134 g.p.m., equals the water of the finished liquor overflowing from thickener No. 1, 122 g.p.m., plus the water leaving the system with the calcium carbonate cake from filter *Y*, 12 g.p.m. This water is metered and supplied at a constant rate, passed through a tubular heater to raise its temperature to about 90 deg. C., and applied as a wash on filter *Y* and as a wash in thickener No. 3.

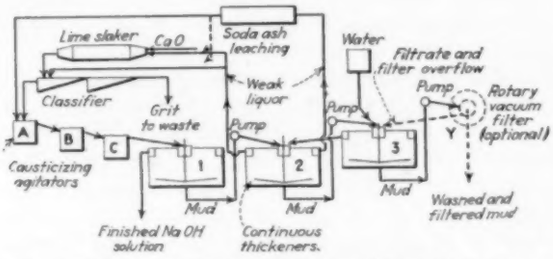


Fig. 7—Simple Form of Continuous Causticizing Plant With Counter-Current Washing

A plant of this type carries out causticizing in a single step in three series agitators, followed by one thickener for strong liquor decantation and two thickeners for mud washing. A filter may or may not be added at the end of the series, depending upon whether or not the lime mud is to be reburned or utilized as whiting or as a cement-making material. All wash water is added in thickener No. 3, the overflow from which serves as a wash in thickener No. 2. Thickener No. 2 overflow is divided into two parts, one of which is utilized for dissolving soda ash and the other for preparing milk of lime.

Weak caustic soda filtrate from this filter and the overflow from thickener 3 flows by gravity into agitator *D*, in which the second stage of causticizing takes place and where these solutions are used to repulp the cake from filter *X*. About 10 per cent of the total sodium carbonate liquor, 6 g.p.m., is added to the contents of this agitator in order to take up the uncombined CaO in the lime mud. The pulp in the agitator flows by gravity into thickener No. 2, which in turn overflows 140 g.p.m. of weak solution of about 4 deg. Bé., and discharges a lime mud to thickener No. 3, arranged in series with filter *Y* for washing this mud.

Weak liquor overflow from thickener No. 2 is divided into two parts. One part, about 70 g.p.m., is used to dissolve soda ash, and the other, also about 70 g.p.m., to prepare milk of lime. That portion used for preparing milk of lime is further divided into two parts, of which the smaller enters a rotary slaker, where it is used to hydrate the burned lime, added at constant rate by a mechanical feeder, while the balance of the weak liquor joins the discharge from the slaker, diluting it to the point where grit and other impurities segregate readily in the classifier and leave a smooth, grit-free milk of lime for causticizing.

About 90 per cent of the soda ash solution, 64 g.p.m., and the milk of lime enter the first of three causticizing agitators, where the mixture is mildy agitated in covered, insulated, and steam-coil-equipped tanks which are arranged on slightly different elevations to permit

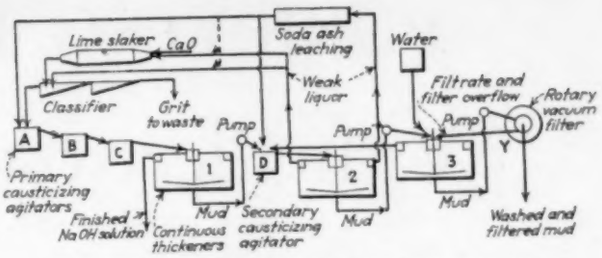


Fig. 8—Flow Sheet With Double Causticizing for Reaction Forcing

This layout differs from Fig. 7 in that a secondary stage of causticizing intervenes between the thickener used for strong liquor decantation and the first of the thickeners used for mud washing (agitator *D*). A heavy excess of lime is carried in the primary stage of causticizing in order to force the reaction in a minimum of time. After strong liquor decantation, the lime mud, containing appreciable quantities of free lime, is diluted with weak wash solution and reagitated with additional sodium carbonate which takes up some of the uncombined CaO. The overflow from the second thickener is used for milk-of-lime preparation and soda-ash dissolving and the mud is washed counter-currently in the remaining thickeners in the usual manner, with or without a vacuum filter at the end of the series for mud dewatering.

gravity flow through them. An excess of about 5 per cent of lime and an elevated temperature assure rapid conversion, while the precautions taken in lime slaking and in rate and duration of agitating assure the formation of a coarse precipitate, readily settleable and filterable subsequently.

Strong liquor decantation takes place in thickener No. 1, the mud from which is further dewatered on filter *X*. It is the purpose of this arrangement to recover the maximum quantity of caustic soda solution at the original strength of 15-18 deg. Bé., and at the same time to pass on to the washing operation a lime mud containing the absolute minimum of caustic soda solution.

In this flow sheet there have been embodied certain advanced ideas of reaction forcing; governing of the physical character of the precipitates; controlling of the flow; and disposition of the wash solutions. Also, full advantage has been taken of layout possibilities.

While it is true today that the reactions involved in causticizing sodium carbonate with lime are substantially

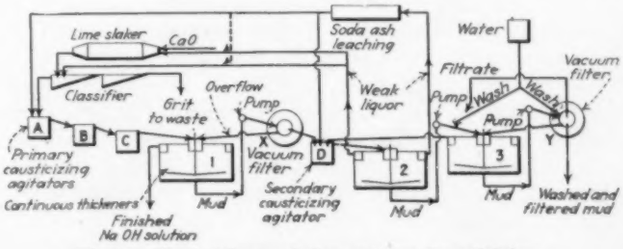


Fig. 9—Most Advanced Layout for Causticizing Adds Filters

This arrangement is similar to that in Fig. 8 in that double or two-stage causticizing is practiced, but it differs in that vacuum filters are used in conjunction with the thickeners, both for strong liquor decantation and for mud washing. This is of more recent development than the layout in Fig. 8 and since it embodies certain new features of undoubted value from an operating and control standpoint, is discussed at some length in the accompanying text in connection with a typical installation.

those used several generations ago, research and practice have shown that the extent of the reaction and the amenability of the constituents to separation, each from the other, may be controlled by the observation of certain simple precautions of a mechanical nature. Continuous operation of all stages of the process cycle, utilizing mechanical equipment wherever possible, lends itself admirably to the control of the essential reactions and to the simplification of the duties of the operators and the control chemists.

PURIFYING BURNER GASES With Electrostatic Precipitators

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RESULTS presented in this paper are a summary of a year's experience with Cottrell precipitators in the purification of pyrites burner gases for making contact acid with a platinum catalyst. Inasmuch as these Cottrells are of a different design from that customarily employed in this country, the data should be of interest for comparison with the performance of precipitators of the usual type.

An installation of these Cottrells seemed the best solution for the dust problem arising from the burning of lead-bearing ore. This ore contains approximately 1 per cent of lead and consequently the burner gas will contain, in addition to acid mist and iron-oxide dust, an appreciable quantity of lead fume. Acid mist, of course, can be readily removed by a coke filter. The combination of iron-oxide dust and acid mist can be handled by installing a dust collector of some sort and a preliminary filter of relatively coarse coke to prevent the fouling of the main coke box by any uncollected dust. This dust necessitates cleaning the preliminary filter at intervals, which is something of a nuisance.

This nuisance is greatly aggravated by the presence of lead fume in the burner gases, inasmuch as the very fine nature of the lead sulphate particles brings about a much more rapid rate of increase in resistance of the preliminary filter than would a similar amount of iron-oxide dust. Obviously in this case, any type of mist remover which has a large amount of unpacked area and is as efficient as the coke filter would be a more desirable installation. The Cottrell readily meets the first specification and is guaranteed to meet the second. A Cottrell dust precipitator also was installed as it was understood that its efficiency was higher on this particular kind of dust than that of any other type of collector.

Precipitator units were designed and installed by the Research Corporation. Their construction is shown in the accompanying drawings, Figs. 1 and 2. It will be seen that the dust collector or hot Cottrell (Fig. 1) consists of a brick chamber having two separate compartments in parallel. Each compartment has seven collecting electrodes arranged parallel to one another. Each electrode is 10x4 ft. and is a two-mesh screen of 10-gage steel wire riveted to a steel frame. Between the collecting electrodes are the precipitating electrodes made of chrome steel wire. The whole system is hung from a frame and is cleaned by rapping the frame, the resulting vibration dislodging the dust. Dampers are arranged so that either chamber can be cut out for cleaning or repairs. Dust drops into the hopper-like portion of the shell and is then dumped through a gate valve into a lower compartment. This Cottrell is operated at 50,000 volts.

The mist-collecting unit or cold Cottrell (Fig. 2) consists of three parallel pairs of lead chambers arranged in series. These are separated electrically, the first pair, or primary unit, on one circuit, and the last two pairs, or secondary units, on another. Collecting electrodes here are lead sheets, five in each primary chamber, and six in the secondaries. Precipitating electrodes are lead-covered copper wires. The whole precipitating system is suspended as in the hot Cottrells. It will be noticed that the electrodes in the primary precipitators are arranged at right angles to the gas stream while those in the secondary units are parallel to it. This was intended to bring about better distribution of the gas, but has in fact resulted in channeling, most of the gas rising through the

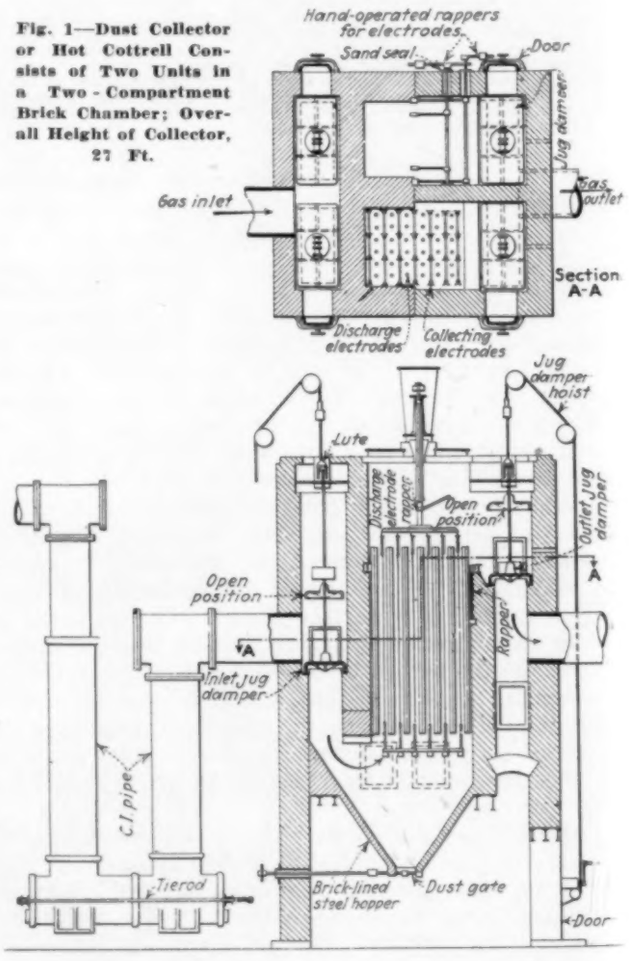

Fig. 1—Dust Collector or Hot Cottrell Consists of Two Units in a Two-Compartment Brick Chamber; Overall Height of Collector, 27 Ft.

Paper presented by the author, under the title of "Some Experiences With Cottrell Precipitators in the Purification of Burner Gases," at the June, 1930, meeting of the American Institute of Chemical Engineers in Detroit, Mich.

ducts on the outlet side. It is expected that an increase in the area of the holes in the distribution plate on the inlet side will correct this.

It will be noted that the conductor enters each chamber through an oil seal and that dry purified burner gas is introduced into the seal chamber from a bypass on the pressure side of the blower to prevent short-circuiting due to condensation of moisture.

All units have a water seal at inlet and outlet so that any unit or combination of units may be cut out of the system. This is a very desirable arrangement, but in this case the seals were not large enough, and the center baffles have been cut out to lower resistance. Both primary and secondary units are operated at 63,000 volts, and the secondary circuit is so arranged that any shutdown will stop the blower and prevent any impure gas from being introduced into the converters.

There is, of course, a transformer station, not shown in the figures. Each unit has its own switchboard, rectifier, and transformer. The daily cleaning of the apparatus requires that the units be interchangeable, and a suitable arrangement of busbars is provided so that all three can be operated on one rectifier and transformer.

Power consumption of the three units is approximately as follows:

Hot Cottrell	3.5 kw.
Cold Cottrell, primary	0.8 kw.
Cold Cottrell, secondary	3.2 kw.

Performance of both hot and cold Cottrells is shown in Tables I and II. These results were obtained on a unit burning 28 tons of ore per day to a gas containing 10 per cent SO_2. Table III shows the composition of the weak acid precipitated from the mist.

It is of interest in connection with the hot Cottrell results that this unit was operated for a short time on a

Table I—Performance of Hot Cottrells

	Total Dust		$PbSO_4$		Fe_2O_3	
	Mg. per Cu.Ft.	Lb. per Day	Mg. per Cu.Ft.	Lb. per Day	Mg. per Cu.Ft.	Lb. per Day
In	453	2,960	96	620	357	2,340
Precipitated	419	2,720	82	529	337	2,191
Out	34	240	14	91	20	149
Efficiency (per cent)	91.8		85.4		93.7	

Temperature in, 820 deg. F.; temperature out, 655 deg. F.; pressure drop, 0.2 in. H_2O; gas volume, 2,060 c.f.m. at 0 deg. C. and 760 mm.

Table II—Performance of Cold Cottrells

	H_2SO_4 Mg. per Cu.Ft.	As_2O_3 Mg. per Cu.Ft.	$PbSO_4$ Mg. per Cu.Ft.
In	168.0	5.2	7.75
Out, primary	4.2	0.13	0.019
Out, secondary No. 1	0.23	0.0023	0.0031
Out, secondary No. 2	0.015	0.00013	0.0007

Temperature in, 85 deg. F.; temperature out, 70 to 95 deg. F.; pressure drop, 1 in. H_2O; gas volume, 2,800 c.f.m. at 0 deg. C. and 760 mm.

Table III—Composition of Cottrell Drips

	H_2SO_4 Deg. Bé	As_2O_3, Mg. per C.C.	$PbSO_4$, Mg. per C.C.
Primary	20.0	9.0	7.1
Secondary No. 1	11.5	4.5	0.05
Secondary No. 2	*	0.05	0.005

*10 Mg. H_2SO_4 per c.c.

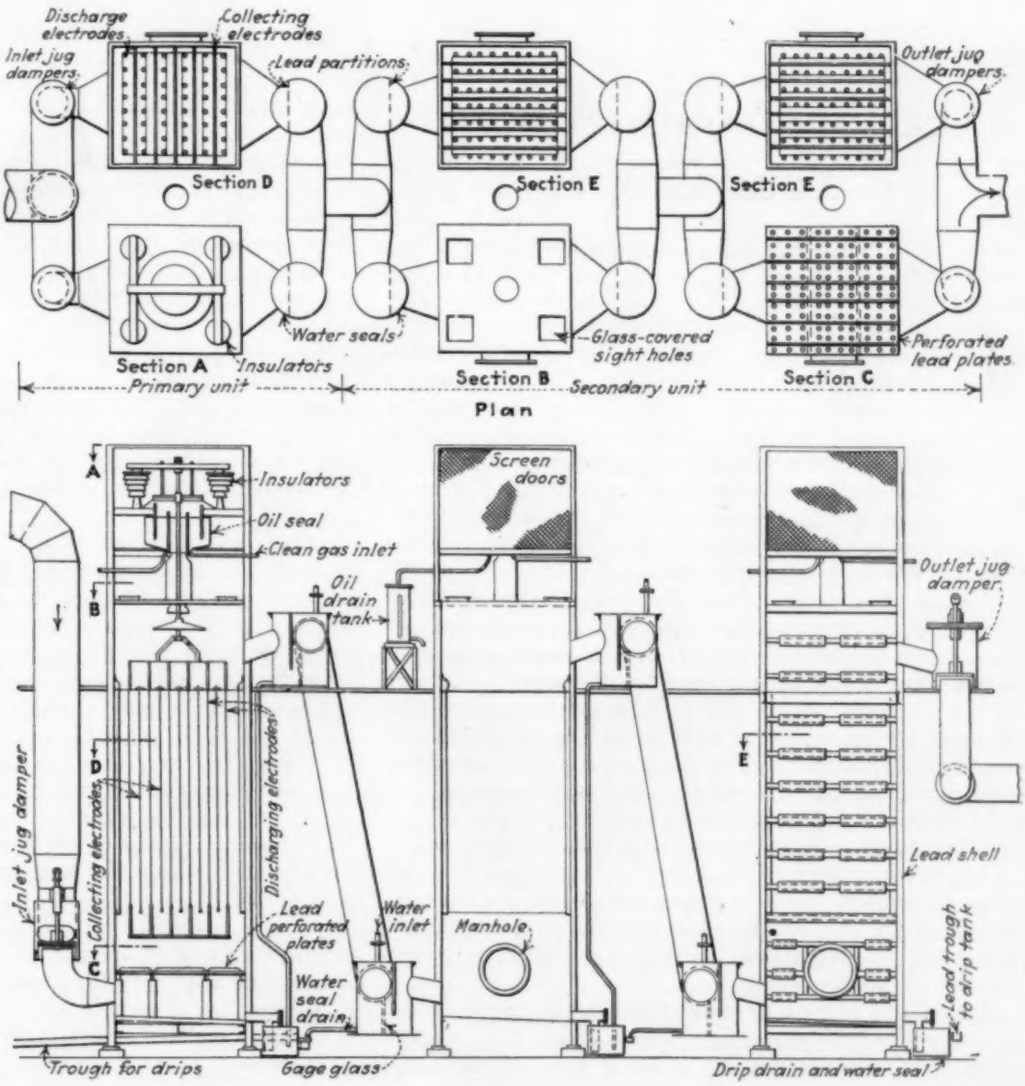

Fig. 2—Mist Collector or Cold Cottrell Consists of Six Precipitators in Lead Chambers. Each Pair Connected in Parallel and the Pairs Connected in Series; First Pair on One Electric Circuit as Primary Unit and Remaining Four on Separate Circuit as Secondary Unit. Overall Height of Collectors, 27 Ft. 1¼ In.

lead-free ore and an efficiency of 99 per cent obtained. We feel that the results given in the tables may be low, as there are indications that some of the lead shown in the exit test is in the vapor phase in the collector. It may be remarked that there is some leakage of air around the sand lutes on top, the drop in gas strength amounting to about 0.5 per cent, that is, from 10 to about 9.5 per cent.

RESULTS of the cold Cottrell tests bring out several interesting points. First, the equivalent sulphur content of the drip has never amounted to more than 3 per cent of the sulphur burned, or no more than is normally obtained on a sulphur unit. Gas analyses to check this result have indicated that, at the outside, not more than 5 per cent of the sulphur burned is converted to SO_3. Our past experience with pyrites had led us to expect a conversion of 7 per cent of the sulphur ahead of the Cottrells.

Another point of interest is the fact that the acidity of the condensate from a long flue, connecting the Cottrells and the dry tower, is normally equivalent to an H_2SO_4 concentration of 0.5 to 1.0 mg. per cubic foot in the gas. The mist test, of course, shows nothing like this, as the difference between the exit of the Cottrells and the entrance of the dry tower is only 0.01 mg. H_2SO_4 per cubic foot. The reason for the discrepancy, which must be due either to error in analysis or to oxidation in the flue, has never been determined to our satisfaction. In any case, the result is as good as that obtained on a coke filter by the same method.

Somewhat the same situation exists in regard to the arsenic results. Our arsenic content entering the dry tower is about one-half that shown at the exit to the Cottrells. Although the arsenic in the flue condensate checks this difference quite well, the final arsenic concentration is at the upper limit of what we have been given to understand is the permissible arsenic content of burner gases for use with a platinum mass. However, we have not had any signs of poisoning and, what is more conclusive, our gases are in no worse condition than those leaving a coke filter, when tested by the same method. Incidentally, the method used to obtain the above results is the ordinary method for determining acid mist by filtering the gas through asbestos and leaching. Arsenic is determined by the Gutzeit method on the leach liquor. This method gives results that are twice those obtained by the customary method of bubbling the gas through water.

EXIT TEMPERATURE variation shown is due to the difference between atmospheric temperatures in winter and summer. No air leaks in the cold Cottrells have been noticed.

In conclusion, I think we can say that our experience with these units during the past year has been satisfactory. We have had no electrical difficulties and the efficiencies obtained have been all that was expected.

▼ ▼ ▼

Letting Youth Absorb Your Gospel

By JAMES H. COLLINS
Los Angeles, Calif.

JUST a few months ago, a beautiful "hall of humanities" was opened at California "Tech.," in Pasadena. At Dabney Hall, the humanities are to be taught with an adequate staff and plant, instead of being the Little Orphan Annie of technical education. At the dedication, Dr. William B. Munro spoke of the men who have been recruited into the engineering profession without cultural backgrounds, social sympathies, or acquaintance with "the imponderable forces which even engineers have to take into account."

Within five years, these "humanics" probably will be quoted above par at all technical schools, and many of the old boys out in the world of engineering will either wish that they had enjoyed the new advantages or may find time to go back for post-graduate work that includes literature, history, philosophy, social ethics, and so forth. However, if the chemical engineer's working experience has convinced him that closer acquaintance with people would be useful to him, he may shape up a course wherever he is, and lose no time in taking it.

Wherever a chemical industry and a high school are found together, there is a hall of the most absorbing humanities. The entrance examination is a little stiff, the principal requirement being some ability to get along with young people.

By an odd turn in probate affairs, an engineer friend of mine several years ago found himself in charge of a boys' military school. Like a good engineer, he drew up a specification for instructors, and sent it to the nearest colleges, where the prize graduate scholars were chosen to teach his boys.

The boys hazed the scholars! My friend called the boys together, and asked them to give their word of honor to refrain from high jinks. But the boys frankly told him the temptation was too strong. Whereupon, he revised his specification and got a staff of prize athletes, and that was right. They could hike, ride, swim, or play ball with the boys, or put on the gloves with them and work out any superfluous spirits; as far as teaching went, they knew more than enough.

The Colonel now has one of the most popular and efficient boys' schools in the East and says that he himself is the prize scholar, when it comes to having learned things.

If you will take time to get acquainted with the principal of your high school, and quiz him about chemistry, chemical engineering, and the materials, processes, and products of the chemical industry as it is functioning in the world today, you probably will find a state of affairs strongly appealing to your sympathies.

There may be only a single high school in the town where you make phosphoric acid or pyroxylin paint, or your city plant may be ringed around with high schools. No matter—psychologically, you will find them on opposite sides of the globe. I've seen themes, turned in by the young people of an industrial city, dealing with materials, processes and products not to be found within a thousand miles.

"Why not themes on the local brass works, electroplating industry, paper mill or garnet mine?" one asks, and is told that the young people know all about local industries; their parents are connected with them; they themselves will be seeking jobs in a year or two; there is no money; there is no time; the local industries have

never manifested any interest in the school work—and so on.

No visits to plants, no friendly talks by men from the brass works to tell the young people what it is all about, and give them a general picture of the brass business. Later on, these young men and women will secure office or mill jobs, which may lead anywhere or nowhere, because they do not understand the purpose and progress of brass from the mines to the building job.

ANOTHER thing—most of the technical teaching in schools is five to ten years behind current practice, to say nothing of lacking the thrill of future improvements. So the chemical engineer who volunteers his services as a guide through his own technical world will be performing something bordering on public service, besides establishing one of the finest kinds of human contact.

Full of surprises! Because young people of high school age are living in one of four distinct mental periods through which we all pass on our way from the cradle to the ballot.

From three to six, children play at being grownups, dramatizing adult life, pretending they are firemen, storekeepers. From seven to eleven they are full of energy—rough, cruel, chasing Indians. From eleven to fifteen, the gang spirit rules, and from fifteen to eighteen they are romantic.

This is the high school age, at which, let us assume, the master technical mind of the local gas works steps in. It is the age when sex has become an ideal as well as an interest, and hero-worship is inextricably entangled with sports. Even "hard-boiled" modern youth, though it may have decided to make millions, does not yet "process" its day dreams, psychologically speaking. The millions-to-be are still thought of as results—the buried treasure of the Incas—and no mental steps have been taken toward accumulating the first thousand dollars.

It may be the privilege of the technical mind to show Youth that these aerial millions are extractable from the gas industry. Here is exactly the place to get together. Youth has its dream, and shortly will encounter obstacles when it goes out into the world to realize it. The technical mind is already out in the world, dealing with obstacles and, let us hope, having some fun doing it.

Youth can be shown, briefly, that the gas industry has been fighting villains, typified in the first objections raised against gas pipes as well as in the present-day villain, Cost.

One of the earliest chemical industries, constantly developing new byproducts, entering minutely into the common-place things of everyday life, as the color of silk stockings, and spreading out to cover all community life, with its service to the home and to industry, its future objective of smokeless cities, a sturdy business that has refused again and again to succumb to new competitors—the gas business, pictured to youth by an imaginative technical man, can be an Aladdin's cave in itself, and a point of departure for almost endless excursions into industry. The industrial uses of gas can be followed up in other local plants, and its byproduct industries explored in trade and technical literature, if there are no dye works, textile plants, and the like at hand.

It is not inconceivable that the gas engineer might himself learn something by leading Youth in such explorations of the modern world. Actual acquaintance can be begun in various ways. Gas companies have been rather eager to be understood by the public—for commercial reasons—or to lighten the burden on complaint departments. So, the commercial department would welcome the technical man's suggestion that high school students be shown the wonders of gas in the production department.

Invite the high school principal to lunch, ask him what he thinks of the idea, and if he likes it, take him through the plant. Invite the students themselves, or part of them—maybe the chemistry class. Really, the art of introducing one's self to strangers is easy, because it is necessary only to find out two or three facts about the principal, or the football coach, and drop them a note, admiring their work, saying you've often wondered how they did it—will they do you the honor of taking lunch?

Scotland Yard does not like reporters, but I once was able to spend a very pleasant week in its school for recruits, through writing to Inspector Henry and expressing appreciation of a book he had written. That raised me from reporterhood to authordom; and it was a good book—his treatise on fingerprint identification.

Well, having caught your students, be prepared to handle them. When you talk to a crowd of men, they are likely to ask questions, and even to argue with you. Now, students just sit and drink in the wisdom you pour out before them. Your lightest word is accepted as gospel. They have no practical experience against which to check you up. They are at the absorbing, awkward age, when they do not know how to express their opinions about you. Presently you will begin to respect yourself as an outstanding authority on the technique of gas.

Then, one day, out of a blue sky over a peaceful world, there will come a thunderbolt: these boys and girls regard you as a great man because they think you an old man!

All that apparatus you have shown them, all the surprising things you have told them about it, make you a hero. So, long before you reach the chloroform age, you can be a seer and a patriarch, by this method, but never a hero ranking with their athletic idols. It is a vibratory process, which after a while shakes you down into your proper place, and when you drop through your correct mesh, look forward to some pleasant times of companionship and confidences.

THOREAU SAYS something about, when one has a castle in Spain, building foundations under it. These boys and girls will diffidently reveal to you their ambitions and dreams, and you may suggest practical methods of realizing them, a branch of the construction business with a high and constant peak of demand.

Girls? Oh, yes! They go to high school too, you know, and although they will marry, their interest now in the workaday world is as strong as that of boys. Before becoming wives, they will work, and gain experience of practical affairs, and always afterward their concern in the practical affairs of their husbands and sons will be strong, and the more tangible for their having had working experience.

As a writer, I can assure you that clear articles about business have a wide circle of women readers. Also, that the petticoat influence in business today is greater than ever.

If more human contacts be desirable for technical men, here is another world of people where the engineer may enter easily, and learn to know his kind.

FLUIDS HANDLING

By W. L. BADGER
and
E. M. BAKER

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The first of three articles on the transportation of liquids and gases. Although written primarily for the younger engineer, these articles contain much that can profitably be reviewed by the experienced engineer.

TRANSPORTATION of fluids is one of the most important unit operations in chemical engineering. The transportation of material in fluid form is so much more convenient and economical than transporting solids that, wherever possible, materials are moved in the form of liquids or solutions. The following pages, therefore, as well as two later articles, will deal with the apparatus used in moving fluids. In the present article, pipe, fittings, and valves will be taken up in turn. Pipe is made of many special materials for special purposes, but iron pipe is used so much more widely than any other form that it will form the basis of this discussion.

Cast-Iron Pipe—This is used mainly for underground lines that carry relatively non-corrosive liquids. It is heavier and more expensive than varieties of pipe to be described later, and the joints are less satisfactory. It has an appreciably greater resistance to corrosion than ordinary iron pipe. It is regularly made in sizes of 3 in. nominal inside diameter and larger. The standard length is 12 ft. on the straight section. Other lengths are special. The commonest joint for this class of pipe is the bell-and-spigot, which is cast with one end belled out and the other with a bead or "spigot" at the tip.

Dimensions of this joint are specified in every detail by the American Water Works Association. In assembling the joint, the bottom of the space between the spigot and the bell usually is calked with oakum. On top of this, lead is cast; and this lead is then calked into place with blunt chisels, in such a manner that the lead is compressed to fill a groove on the inside of the bell. Sometimes instead of melted lead, a fibrous form of lead called lead wool is used; or portland cement, asbestos rope, or other materials may be used instead of oakum.

A PROPERLY MADE bell-and-spigot joint will hold pressures up to 100 lb., and has the advantage that it does not require the two pipes to be in perfect alignment when the joint is made. Ordinarily, however, it is considered unsafe for pressures over a few pounds per square inch, and some of the more elaborate joints not discussed here are used for the higher pressures.

Iron Pipe—In speaking of the materials of which pipe is made, the term "iron," when used without other qualifications, always means a low-carbon steel. When one speaks of steel pipe, he usually means a special pipe made of a higher carbon steel. Cast-iron pipe and wrought-iron pipe always are referred to as such, although much mild steel pipe still passes for wrought iron.

Iron pipe is made by rolling a flat strip or skelp to the proper width and thickness. For pipe under 1½ in. this skelp is then drawn through dies and butt-welded in one operation. Pipe over 1½ in. is lap-welded by drawing so as to bring the edges over each other, reheating to a welding heat, and running through a pair of welding rolls. The butt-weld is less desirable. The standard length of iron pipe is approximately 20 ft. The skelp may also be rolled into a spiral and the edges riveted. Spiral riveted pipe usually is made much thinner-walled than the standard and is used for temporary or light work principally.

Briggs Standard—Iron pipe is regularly drawn to the Briggs standard gage. This specification covers not only the dimensions of the pipe but the details of the threads that are used on it. Pipe threads are finer than standard machine threads, are tapered, and usually are right-handed. It should be noted particularly that the nominal size of the pipe (i.e., 1-in. pipe, 1½-in. pipe) is only an approximate dimension, and is neither the inside nor outside diameter. Thus ½-in. pipe is approximately ⅝ in. inside diameter and ⅞ in. outside diameter. In the larger sizes the nominal size is nearly the actual inside diameter.

BRIGGS STANDARD does not include sizes over 12 in. Larger pipe is known as large O.D. and is specified by actual outside diameter and wall thickness.

Iron pipe is made also in extra-strong and double-extra-strong thicknesses. In such cases the outside diameter and the threads are the same as those of standard pipe, and the extra thickness is on the inside. This is so that all weights of pipe may be threaded with the same standard dies and used with standard fittings.

Tubing—Copper and brass especially, and to some extent iron, nickel, and other metals, are sold in the form of tubing rather than pipe. Pipe is specified by its approximate internal diameter (nominal diameter), but tubing is sold on the basis of actual outside diameter and wall thickness. Tubing of a given outside diameter usually is drawn in a variety of wall thicknesses, so that both must be specified. In the case of copper, brass, and iron the material can be obtained either as pipe (conforming to the Briggs standard) or as tubing drawn to an exact outside diameter, and with a wide range of wall thicknesses for each size.

Fittings are used in pipe lines for: (1) Joining two pieces of pipe; (2) changing the direction of the line; (3) changing the diameter of the line; (4) connecting branch lines; (5) stopping the end of a line; (6) controlling the flow in the line. It is obvious that in many cases two or more of these functions may be combined in the same fitting.

The commonest material of which fittings are made

This and the succeeding two articles will later appear at greater length as one chapter of a book by the authors, to be published as part of the Chemical Engineering Series by the McGraw-Hill Book Company, under the title of "Elements of Chemical Engineering."

is gray cast iron which is used for probably 90 to 95 per cent of the fittings used in ordinary chemical engineering practice. Where vibration is serious and there is danger of cast iron cracking, malleable iron may be used. For high pressures or severe service, cast-steel fittings are available; and for exceptional cases fittings forged from mild steel are on the market. These latter are relatively expensive and are used only where the service is severe either from the standpoint of pressure or of secondary strains.

Fittings usually are rated as low-pressure, standard, extra-heavy, and hydraulic. The low-pressure usually is rated at 25 lb. per square inch for steam or air, the standard at 125 lb., extra-heavy at 250 lb., and hydraulic in varying classes from 300 to 10,000 lb. per square inch. These pressures have no direct relation to the breaking strength of the fittings. A wide margin of safety is allowed between the actual bursting strength of a fitting and the pressure for which it is rated, to take care of expansion strains and shocks from water hammer. In fact, in many cases where the pressure is no greater than would be allowed for standard fittings, but where strains due to expansion may be serious, extra-heavy fittings may be used.

Pipe Joints—Two pieces of pipe may be joined in a variety of ways. Only the most important of these will be mentioned. The first group, couplings, are short sleeves threaded internally on each end. One coupling is regularly furnished with every length of pipe. Couplings are considered bad practice in sizes over 2 in., but are sometimes used, especially where the joint is made up in the shop and not in the field. A second means of joining pipe is the union, which consists of two threaded pieces screwed to the ends of the pipes being joined, which are then drawn together by means of a threaded collar. The better unions have brass rings pressed into them to serve as a seal, and these rings are finished to spherical surfaces of different radii so that the joint will be tight even if the pipe is slightly out of alignment. Less desirable types either do not have the brass rings, in which case rust makes it difficult to obtain a tight joint, or else require packing which needs replacement at intervals.

Screwed joints are not considered good practice in sizes above 2 in., for several reasons. First, it is difficult to make the pipe thread enter the fitting on large sizes. Second, threads over $2\frac{1}{2}$ in. usually must be cut on a machine in the shop rather than with hand tools. Third, the wrenches needed to tighten threads on pipe 3 in. or larger are often difficult to handle.

Flanges are the universal method of connecting pipe of sizes over 2 to $2\frac{1}{2}$ in. They may be classified by methods of facing and methods of attaching. Such a classification is as follows:

Methods of Facing	Methods of Attaching
Plain face	Screwed
Grooved face	Shrunk
Raised face	Riveted
Polished face	Welded
Male and female face	Swiveled
Tongue and groove face	

With the exception of the grooved-face flange, which is merely a modification of the plain face, all of these types of facing are illustrated in Fig. 1, while the methods of attaching are shown in Fig. 2. Complete descriptions of the methods are given in the captions.

Another type of joint widely used, especially for gas and oil lines, is the ring joint, shown in Fig. 3. These joints may be easily and quickly applied, provide for some expansion, and do not require that the pipe be perfectly aligned. The packing ultimately fails and the joint is not self-supporting. Consequently, they are seldom used in ordinary plant service, but are common on underground lines. This joint is known under a variety of trade names, but is perhaps most commonly spoken of as the Dresser joint.

Expansion Joints—All pipe lines of any considerable length in which there may be a change of temperature must be provided with some means for relieving the stresses which are caused by expansion. This may be done by making a number of turns in the pipe, either with ordinary fittings or with special bends. These turns are so located that no one of them receives more than a fraction of the total stress. Sometimes, for low pressures, a joint consisting of a short length of flexible copper tubing is used. The usual expansion joint, however, is merely a packed slip joint with a stuffing box at one or both ends.

Fittings Proper—When a joint fills any of the functions 2 to 5 inclusive, in the foregoing outline, the connection is made by a fitting. For changing direction, these usually are ells. For introducing branches, they are tees, crosses, or Y-bends. For changing the size of the pipe in a straight run, a reducer is used; or if this

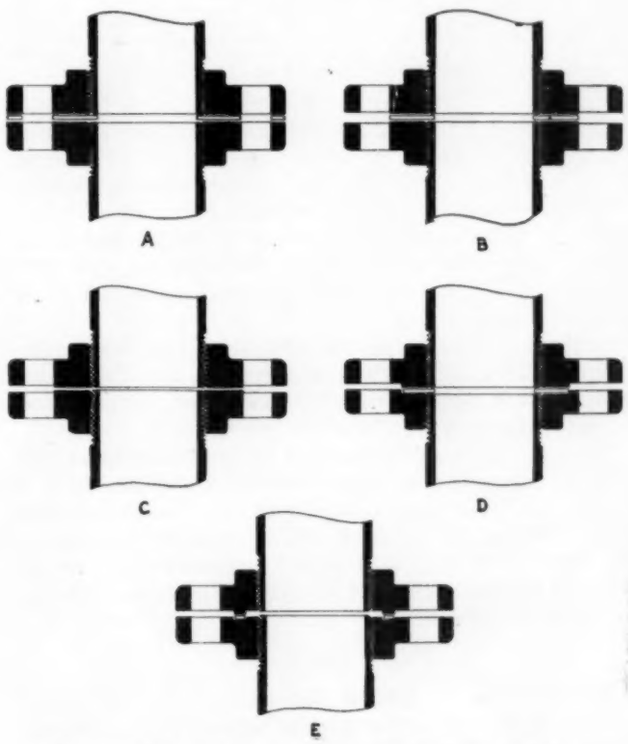


Fig. 1—These Are Various Methods of Facing Flanges

A, the plain-faced flange, is of obvious construction. The grooved face is made by taking a light cut in a lathe over the whole face with a round nosed tool. This gives a better grip on the packing, but is only used for low pressures and soft packing. The raised-face flange, *B*, is used regularly on all fittings designed for steam pressures of 250 lb. or higher, and is often considered good practice for pressures lower than these. The gasket on the plain-faced flange usually extends to the rim of the flange. If considerable tension has to be put on the bolts in order to make the joints tight, the flange may spring enough to make contact around the outer edge without being tight at the center. As higher pressures usually call for thinner and harder gaskets, this condition is aggravated with such packings.

The standard height of the raised face is $\frac{1}{16}$ in., and the gasket is cut to cover the raised portion only. In this way the full pressure of the bolts comes on the gasket without any possibility of the edges of the flanges meeting.

The ground joint, *C*, is used only when there is no gasket material available that meets the service conditions. It is very difficult to make tight, and is very rarely used. The tongue and grooved face, *E*, and the male and female face, *D*, are used for pressures so high that there is danger of blowing out the gasket.

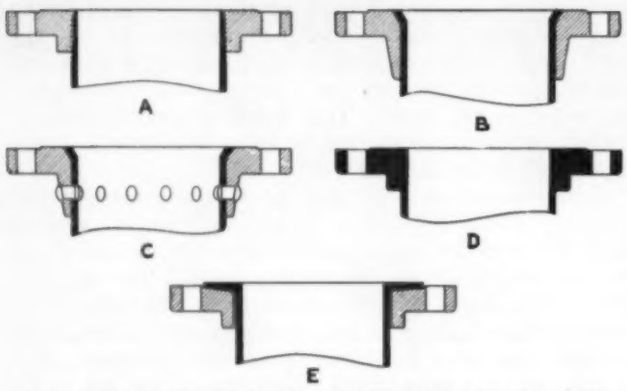


Fig. 2—Five Principal Methods of Attaching Flanges to Pipe

The standard method, *A*, is to thread the end of the pipe and screw on the flange. For exceptional service the flange may be shrunk onto the pipe, as in *B*, in which case the outer face of the flange has a tapered opening and the pipe is spun out into this taper. In some cases flanges have an extra long hub, and in addition to being screwed or shrunk to the pipe are riveted through this hub, as in *C*. This additional precaution is practically never used except in marine work, where it is considered an additional safeguard against the joint loosening from vibration.

Flanges may be welded to the pipe, either by the torch method or by the ordinary forge and hammer method; however, cast iron flanges cannot be welded to iron pipe, so steel flanges must be used. This method is used in high pressure work or central station practice. Finally, the end of the pipe may be upset after a loose flange has been slipped over it, and then faced off to form the actual contact surface, as in *E*. This has the advantage that since the flange is loose on the pipe, bolt holes may always be brought into alignment even on complicated assemblies. It has the disadvantage that every individual piece of pipe is a special forging, and repairs are slow and costly. Practically every manufacturer of pipe and fittings has some slight modification of this joint which he calls by a special name. It usually passes in common parlance under the name of the Van Stone joint.

function is to be combined with the function of another fitting, the openings in the fitting may be of unequal sizes, in which cases they are called reducing fittings. The most common method of changing the size of a line, however, is by means of bushings in small sizes or reducing flanges in larger sizes. To close the end of a line, plugs or caps are used in small sizes and blank flanges in large sizes.

A short piece of pipe, threaded at both ends, is called a nipple. A close nipple is one so short that the threads meet; a short nipple is one that has a very short shoulder (approximately $\frac{1}{4}$ in.) between the threads.

Fittings may be threaded and screwed directly to pipe. This is not considered good practice in sizes over 2 to $2\frac{1}{2}$ in. Universal practice in larger sizes is to use flanged fittings which are attached to corresponding flanges on the pipe. The flanges of such fittings are faced to correspond to the method of facing used for plain flanges in the same pipe line.

Cocks and Valves

Devices used to control the rate of flow of liquids in a pipe line show an even wider variety than do fittings. They may be classified as follows:

Plug Cocks	Gate Valves	Check Valves
Globe Valves	Non-rising stem	Ball check
Metal disk	Rising stem	Swing check
Composition disk (Jenkins type)	Outside screw and yoke	Reducing Valves

Cocks—Cocks are the simplest method of regulating the flow of fluids. They consist essentially of a body casting, in which fits a conical plug with a passage through it. This must, of course, be closed by some sort of packing around the stem. Cocks are universally used on small lines for compressed air, but rarely for steam or water. Cocks may stick if the plug taper is too little, or leak around the plug if it is too great. Most cocks tend toward the former difficulty. To remedy this, there are a number of special designs on the market, one of the best known of which has lubricant inserted at the stem of the cock. The lubricant is transmitted to the working faces through small holes drilled through the body of the plug. This is satisfactory for ordinary service, but in special cases it is difficult to find greases which will not melt or be dissolved.

Another disadvantage of cocks is that when the bore is cylindrical, as is often the case, the area of the opening in the pipe changes very rapidly with a slight amount of rotation when the cock is just opened, and changes practically not at all when the cock is nearly open. Consequently, it is difficult to regulate flow with a cock, especially at low rates of flow that call for fractional openings. Cocks usually are used, therefore, where they will be either wide open or completely closed.

Globe Valves—The essential feature of these valves is a globular body with a horizontal internal partition, having a circular passageway in which is inserted a ring

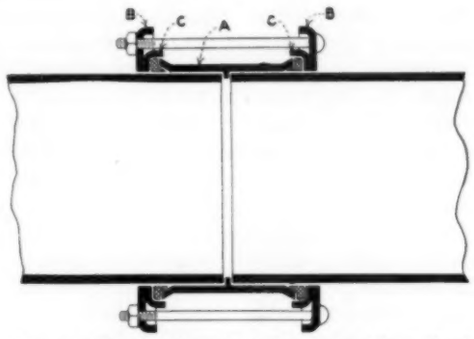


Fig. 3—Ring Joints of This Type Are Much Used for Oil and Gas Lines

A loose sleeve, *A*, is slipped over the joint, and this sleeve is so formed that it functions as a stuffing box on either end. At either end of the sleeve is a flange, *B*, with a projecting ring, *C*, which closes the stuffing box and compresses the packing.

called the seat. The action of the valve consists in screwing down the valve stem carrying the valve disk, thus closing the opening in the central partition. Although there are a large number of globe valves varying in cost and ability to withstand pressure, the main differences pertain to the construction of the valve disk and valve seat. The cheaper valves have no separate seat ring, but the better valves have this feature for ease in renewal. The two main types of valve disks are the metal disk and the composition disk. Globe valves ordinarily are used in smaller sizes. It is generally considered poor practice to use a globe valve in a size larger than 2 in.

Gate Valves—Gate valves are universally used in the larger sizes and can be obtained in a wide range of costs, materials, construction, and mechanical details. In the rising-stem gate valve, which is the simplest type, the valve body contains a straight channel for the flow of the fluid, and this is partly or completely blocked by the gate, which is raised and lowered by the threaded valve stem. In the non-rising stem valve, the distinctive feature is the fact that the thread of the valve stem engages the gate, and the gate rises and falls without the stem rising and falling through the stuffing box. The non-rising-stem valve has the advantage of requiring less over-all length when open than does the corresponding rising stem valve.

Severe pressure on the gates is a controlling factor in large valves. This not only requires heavy gate construction but makes it difficult to open the valve manually. In such cases large gate valves are often equipped

with small bypass valves which allow equalization of pressure on the two sides of the gate before opening the main valve.

A third type of gate valve is known as the O. S. & Y. (outside screw and yoke). Use of this valve is limited to large sizes where it is necessary that the size of the bonnet casting be cut down to reasonable dimensions. In this type the handwheel ordinarily is threaded and lifts the stem without itself rising or falling.

Q. O. Valves—Whereas gate valves have threaded stems which require a number of turns to open or close the valve completely, the so-called "Q. O." (quick opening) valves have smooth stems, operating a sliding or rotating gate, and are opened or closed by a lever handle in a single operation. Such valves are convenient but involve the danger of a water hammer.

Water Hammer—When a pipe contains a column of moving liquid, there is considerable kinetic energy stored in the liquid by virtue of its mass and velocity. If the velocity is suddenly destroyed (by the quick closing of a valve or cock) this energy cannot be absorbed, since the liquid is nearly incompressible, and therefore appears as an instantaneous shock which may represent excessively high pressures. This effect is greater as the pipe line is longer, the velocities higher, and the time of closing the valve shorter. Fairly long lines may contain enough mass of liquid to produce a water hammer of sufficient intensity to break fittings. Q. O. valves, therefore, should be used only on short lines. Cocks are open to the same objection if they are quickly closed.

Check Valves—Check valves are used when uni-directional flow is desired. They are automatic in operation and prevent flow in one direction, but allow it in the other. In general, there are two types: one uses a hinged flapper which is seated by flow in one direction but opened in the other, while the second type substitutes a ball and a conical seat for the flapper.

Reducing Valves—Reducing valves are used where it is desired to maintain in one part of a system uniform pressures lower than the pressures in another part of the system. The construction and operation of these valves show an even wider variety than any of the divisions discussed before. The valve shown in Fig. 4 is merely one type of a very large class. This valve is designed for maintaining a constant but lower pressure on the outlet side than the pressure existing on the inlet side. When these valves operate properly, the main valve, *A*, does not completely open or completely close, but maintains a balanced position, and fluctuates up and down as the pressure on the right-hand side tends to fluctuate. Practically all regulating valves operate on a principle similar to that used here: namely, a diaphragm, *D*, with a spring or counterweight exerting pressure on one side, is acted upon on the other side by the pressure which it is desired to maintain constant. Fluctuations of the pressure cause corresponding fluctuations in the diaphragm, the movement of the diaphragm opens or closes a pilot valve, *G*, and thus moves the main valve.

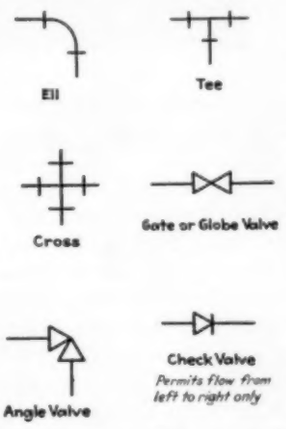


Fig. 5—Standard Conventions for Piping Diagrams

Valve Materials—Valves in pipe sizes of 2 in. and under are usually all brass. In sizes over 2 in. they are usually iron castings with principal working parts such as the seat, the contact faces, the disk, and sometimes the stem, of brass or bronze. Such valves are known as I. B. (iron body) or brass-trimmed valves. For use with solutions which corrode brass, such as ammoniacal or cyanide solutions, all-iron valves can be obtained, but these are not satisfactory for general service, because of the rusting of the contact surfaces. For high pressures or severe service the main castings, instead of being cast iron, may be high-grade bronze or cast steel; and in exceptional cases the whole body of the valve is a single forging in which the necessary openings are machined. For handling superheated steam at high pressures the trimmings, instead of being brass, are usually Monel metal. The brass-fitted cast-iron valve in sizes above 2 in., and the all-brass valve in sizes of 2 in. and lower, are common practice.

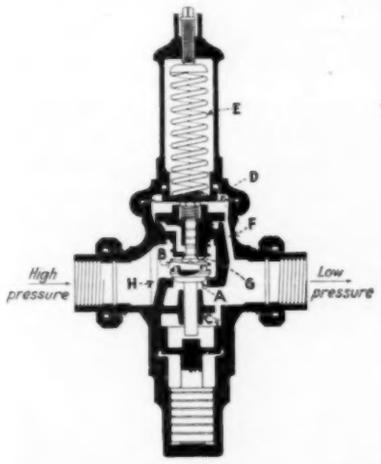


Fig. 4—Principle of This Valve Is Common to Most Reducing Valves

It contains a main valve disk, *A*, controlling the principal supply of fluid (usually steam), which passes from the left-hand to the right-hand side of the valve. This valve disk is closed by the action of the main valve spring, *B*, and is opened by pressure applied to the under side of the main plunger, *C*. In the upper part of the bonnet there is a thin diaphragm, *D*, of flexible metal, which is balanced between the pressure of the regulating spring, *E*, on its upper surface, and the pressure existing on the low-pressure side of the valve, transmitted to its lower surface through port, *F*. Suppose that the pressure at the right of the valve tends to fall. This relieves the pressure on the under side of the diaphragm so that the spring deflects it downward. In so doing, it opens the pilot valve, *G*, and this allows a supply of high pressure steam to flow through a passage, *H*, in the body to the under side of the plunger. The plunger therefore rises, opens the main valve further, and supplies additional steam from the left-hand side. As the pressure on the right-hand side increases, the reverse cycle takes place. The diaphragm is deflected upward, the pilot valve closes, the pressure on the under side of the plunger is decreased, and the main valve partly closes.

General Practice—The following does not pretend to be a handbook on steamfitting, but it will be of value to mention a few general principles. For the sake of appearance, pipe lines should be run in straight lines with right-angled turns; and the running of pipe at odd angles usually is considered careless work, even though it shortens the line and reduces the number of fittings. It is often considered good practice, where a pipe makes a right-angled turn, to use, instead of an ell, a tee with one connection closed with a plug or a nipple and cap. This not only facilitates cleaning but makes it possible to connect into the line without breaking a number of joints. For similar reasons, in long lines of screwed fittings, unions should be inserted at frequent intervals; because if repairs are to be made and a union is not near the point of repair, either the pipe must be taken down to the nearest union or a fitting must be broken. This is an additional advantage of flanged fittings, since any fitting in the line serves the same purpose as a union.

In making sketches, and in drawings in which pipe lines are to be merely indicated, it is customary to use a single line for a pipe, and to indicate, rather than draw, valves and fittings. Standard conventions for such work are given in Fig. 5.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Vanadium Catalysts For Sulphuric Acid

To the Editor of Chem. & Met.:

Sir:—Certain recent publications on sulphuric-acid catalysts have indicated not only a misunderstanding of the nature and merits of successful vanadium catalysts but even of catalysis in general. The classical definition of a catalyst describes such a substance as one which affects the velocity of a chemical reaction without affecting equilibrium conditions in the system. That is to say, the characteristics of the reacting system govern its equilibrium state at any temperature. For example, if one start with a system containing 8 per cent SO_2, 12.9 per cent O_2, and 79.1 per cent N_2, the system in equilibrium at 450 deg. C. will show about 97 per cent of the SO_2 converted to SO_3; at 500 deg. C., equilibrium will mean about 94 per cent conversion; at 600 deg., about 76 per cent, and so on, the conversion at equilibrium decreasing as the temperature rises. These equilibrium conversions are absolutely independent of the catalyst used, or, for that matter, of the use of any catalyst.

In the case of the oxidation of SO_2 to SO_3, reaction rates permitting of commercial success are not attained with any known catalyst at temperatures below 400 deg. C. With any present-day catalyst the gas enters the converters at a temperature near 400 deg. C., rises to 560-580 deg. C., and then as it passes the latter part of the system drops to about 450 deg. C., or less. The good catalyst, then, is one which will cause the system to reach equilibrium in a short space of time at optimum temperature.

For something like 40 years, it has been known that compounds of vanadium have certain catalytic properties with reference to SO_2. A number of patents have been taken out and much has been written about the subject. Perhaps the most recent publication is that of B. Neumann in *Zeit. für Electrochemie*, vol. 34, p. 696, and vol. 35, p. 42. In these articles, Neumann considers the comparative reaction velocities of silver vanadate, vanadic acid on pumice stone, certain other heavy metal vanadates, and, in the last-mentioned article, ammonium metavanadate on pumice stone. His data are interesting and valuable as additions to the literature of reaction velocities in the system SO_2 O_2 SO_3, but, unfortunately, his derived curves, as published in this country, are subject to some misunderstanding.

In the first place, separated from their context, these curves might be interpreted by one not familiar with the matter, to mean that under any conditions much higher conversions are obtainable with platinum than with vanadium. What they actually mean is that reaction rates with these vanadium compounds are lower than with platinum and that, therefore, more time (or more catalyst, which means the same thing) is required to bring the system to equilibrium. Since no serious attempt appears to have been made in late years to put either silver-vanadate or vanadic-acid catalysts into actual plant operation, it is to be presumed that even the inventors of these catalysts discovered that the loading which they would stand was inadequate for commercial success. However, it is unfortunate that Neumann did not continue his work to cover vanadium catalysts actually in successful use. These are of the type first developed commercially by Monsanto Chemical Works and are adequately described in the patent literature.

Such catalysts, under proper conditions, give 97 to 98 per cent conversions under loadings which are favorable for commercial success. That is to say, reaction velocities are such with these catalysts that equilibrium can be reached quickly at temperatures permitting high conversions. Elaborate research data are not available for the plotting of such comparative curves as Neumann shows, but there is a wealth of actual plant data showing the relative activity of platinum and vanadium.

Briefly the relationship is as follows: New platinized magnesium sulphate and vanadium are identical in operation characteristics. Platinum, however, usually loses some of its activity due to poisoning by minute quantities of arsenic and chlorine which pass the purification equipment. Vanadium is unaffected by these poisons and its activity in actual plant operation has remained unchanged for five years. This consistency of performance indicates for vanadium a very long effective life beyond the five-year period. As a result of this uniformity of performance vanadium gives higher *average* conversions than does platinum.

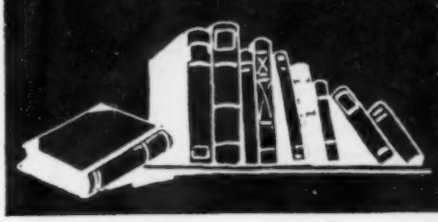
New platinized asbestos has a slightly lower kindling temperature than vanadium. Above 400 deg. C., however, the characteristics of the two catalysts are identical from a commercial standpoint, and since the effective use of either catalyst, as noted above, requires temperatures in excess of 400 deg. C., the lower kindling point of platinum is of no particular interest. Also, as with platinized magnesium sulphate, platinized asbestos loses its activity by poisons which do not affect vanadium, resulting in higher average conversions for vanadium.

The experience of a rather large number of American manufacturers has been that a vanadium catalyst prepared by experts shows consistent results which are better, on the average, than are those from platinum. It might well be said that platinum can be put into a fairly good catalyst by any one, but must have an expert to operate it thereafter, while vanadium requires an expert for its preparation, but is less delicate in operation.

T. R. HARNEY.

Acid Plant Engineering,
Monsanto Chemical Works,
St. Louis, Mo.

Chemical Engineer's Bookshelf



Laboratory Construction

CONSTRUCTION AND EQUIPMENT OF CHEMICAL LABORATORIES: Report of the National Research Council Committee. Chemical Foundation, Inc., New York, 1930. Price, $1.

Reviewed by R. R. WILLIAMS.

OVER a period of two or three weeks the reviewer has put this volume to a practical test as a source of information in connection with a laboratory construction program with which he is concerned. After not only reading the book through but also consulting it in connection with a score of specific questions which have arisen, his verdict is emphatically favorable. The appearance of this report is particularly timely in view of the fact that it follows a decade of unprecedented expansion in chemical activity in the United States. Most of the books and articles covering the same general topic were written ten years or more ago and have now become out of date, largely because of this rapid expansion. There is one other recent book on the same subject, Alfred Behre's "Chemische Laboratorien," Leipzig, 1928. However, this book, quite aside from any inconvenience of language which may be involved, is not very suitable for use in America. European ideas of luxury in labor-saving devices, and particularly in plumbing, are very far from those that prevail in America and, in addition, there is a great disparity in the kinds and comparative qualities of structural materials available for use in Germany and America.

The whole subject of university laboratory construction is excellently treated in satisfactory detail in the Research Council Report. It should furnish abundant ideas and sufficient authoritative information to any competent person contemplating laboratory construction. As a piece of literature which may be handed by the chemist to his prospective architect it should be especially valuable in stimulating his interest and persuading him to depart from convention, where required, in the interest of technical efficiency.

Study of and visits to some 25 of the most modern university and industrial laboratories in the United States have convinced the reviewer that there is very little information in the book which is not truly representative of the ideas which have been recently incorporated in such construction. The chapters on general ventilation and hood ventilation are particularly helpful, especially in view of the fact that hood construction and fume disposal have been revolutionized during the past ten years with great improvement in results.

Avowedly the report deals primarily with university laboratories, which is somewhat regrettable. A small addition to the volume of the work might have served to cover industrial laboratories equally satisfactorily. The number and selection of industrial laboratories chosen for special discussion could be materially improved, especially as the industrial laboratories described are in a number of cases housed in buildings designed for other purposes. However, the thorough treatment of university practice covers the main needs of the industrial organization.

The profuse and well-chosen illustrations throughout the book are especially helpful.

Pyroxylin Coatings

THE CELLULOSE LACQUERS. By *Stanley Smith*. Isaac Pitman & Sons, New York, 1930. 145 pages. Price, $2.25.

Reviewed by S. P. WILSON.

THIS VOLUME is based on a series of lectures on lacquers given by the author at the Borough Polytechnic Institute of London. In concise form he gives an outline of cellulose nitrates and the solvents, plasticizers, resins, and pigments used therewith to form the modern pyroxylin lacquers in accordance, we presume, with English practice. A brief outline of plant and equipment required, a sketch of the industrial applications, a somewhat fuller study of formulation and an excellent and detailed chapter on hygrometry are included.

There are some surprising omissions. Synthetic amyl alcohol and its derivatives and synthetic ethyl lactate are not mentioned, although their derivation via fermentation processes are taken up in some detail. In the chapter on resins, although the Albertol type is discussed favorably, no mention of the Glyptal and Rezyl products is made. Sandarac, mastic, and benzoin resins are heartily approved, which is somewhat surprising. It is possible that, owing to the vast scale on which lacquers are made here compared to England's production, these comparatively rare resins have been considered of too uncertain a supply for our production use.

Under pigments the earth colors and some lakes are mentioned. No space is accorded the fundamental white and black pigments nor the chemical colors such as the chrome yellows, iron blues, and chrome greens. While diethyl phthalate is mentioned as a good plasticizer, the far more important dibutyl phthalate is overlooked. The author is, incidentally, markedly averse to the use of castor oil in lacquers, an opinion not concurred in by the great majority of formulators in this country.

The author writes in a lucid and witty style and the book is interesting to read. However, to one engaged in lacquer production in this country it gives the impression that we are considerably more advanced in both the theory and practice of lacquer formulation than our British friends.

Fermentation Index

AN INDEX TO THE CHEMICAL ACTION OF MICRO-ORGANISMS ON THE NON-NITROGENOUS ORGANIC COMPOUNDS. By *E. I. Fulmer* and *C. H. Werkman*. Charles C. Thomas, Springfield, Ill., 1930. 212 pages. Price, $4.50.

Reviewed by H. T. HERRICK.

IN THIS volume the authors have made a very creditable attempt to provide something that is badly needed in the fermentation field: a condensed and authoritative source to which the research chemist may turn in an attempt to discover if a given product has ever been produced by fermentation, and if so, how. The task of compiling a reference work of this kind is so formidable that the average worker in any section of the field might well find himself discouraged by the immensity of the task. Fortunately for the rest of us, Dr. Fulmer has had the courage and persistence to go ahead, and we are indebted to him. His cross-indexed arrangement of his subject matter into organisms, substrates, and products, although not quite complete, is extremely convenient.

For a book of this kind, however, there is one outstanding prerequisite which one is almost tempted to call indispensable: the work must be complete. When the seeker finds no reference to a given product, he must be able to say: "This has never been formed by fermentation," and base his plans on that hypothesis. It is regrettable, therefore, that in this work there is no mention of such an important industrial application of the fermentation idea as the production of gallic acid from tannin by the action of *aspergillus niger*. Omissions of this type have a tendency to cast a shadow on the completeness of the rest of the work, and give rise to a doubt of its entire reliability.

On the whole, however, the authors are to be complimented on a difficult job well done. No research laboratory which concerns itself in any way with fermentation processes can afford to dispense with this book.

Inventories of Progress

ANNUAL SURVEY OF AMERICAN CHEMISTRY, IV. Prepared by the Division of Chemistry and Chemical Technology of the National Research Council. Edited by *Clarence J. West*. Chemical Catalog Company, Inc., New York, 1930. 550 pages. Price, $4.

Reviewed by D. B. KEYES.

COVERING a period of a year and a half, from July 1, 1928, to Dec. 31, 1929, in order to change the survey from a scholastic to a fiscal year basis, the new Survey maintains the high standards of the other volumes. It is interesting to note that approximately 70 per cent of the contributors to this volume have not contributed previously. The effort on the part of the editor to bring in new viewpoints on old fields is highly creditable and will do much to maintain interest in the Survey.

Several new chapters appear in this volume that have not appeared in the second and third volumes; for example, Electrochemistry, by D. A. MacInnes; Chromium, by W. Blum; Vitamins, by H. C. Sherman; Solvents and Lacquers, by V. C. Bidlack; and Synthetic Resins, by Carl S. Miner. These particular chapters are of unusual interest and the subjects have been covered in such a manner that the important contributions are given without being diluted by too much of the apparently unimportant material.

There seems to be a tendency to give more and more reference to articles of industrial importance. On the other hand, the industrial articles that are mentioned are almost always articles of scientific interest; that is, they are of such fundamental nature that they could not be considered in any sense non-scientific. The idea of accentuating scientific articles of industrial importance from the average reader's standpoint is a good thing. Undoubtedly there will be some criticism, but the reviewer believes that the majority of the readers will be pleased by this selection of material.

There is no question that the Annual Survey of American Chemistry supplies a long-felt want. There is also no question that year after year it is becoming more important as an annual publication for the chemists of this country and, presumably, for our foreign friends as well.

ANNUAL REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY. 1929. Vol. XIV. Published by the Society of Chemical Industry, London. 754 pages. Price, 7s. 6d. to members; 12s. 6d. to non-members.

VERY thorough and well-informed, this publication, like its predecessors, justifiably supplements the American engineer's copy of the National Research Council's "Annual Survey." Where the latter is national, the former covers the important developments in the world at large, over the wide range of chemical industries.

Recent Arrivals

THE SUCCESSFUL CONTROL OF PROFIT. By *Walter Rautenstrauch*. B. C. Forbes Publishing Company, New York, 1930. 239 pages. Price, $3.

THE book is a very sane and stimulating elementary treatise of fundamental accounting purposes. While there is little of novelty, with the possible exception of the "breakdown" chart system, the subject is treated in a way which shows clearly the necessity and fruitfulness of a proper type of cost accounting, financial report, and budget system.

It should be of particular value to the small manufacturing concern, which has frequently too poor a grasp of its own financial fundamentals.

SEVENTEENTH ANNUAL REPORT OF COMPRESSED GAS MANUFACTURERS' ASSOCIATION. Published by the Association, 110 West 40th Street, New York, January, 1930—Contains the proceedings of the seventeenth annual meeting of Compressed Gas Manufacturers' Association, held at Hotel Astor, New York City.

STANDARDS YEARBOOK, 1930. Compiled by the Bureau of Standards. For sale at the Government Printing Office, Washington, D. C. Price, 75 cents—The customary annual review compiled by the Bureau on American and foreign standardization practice.

AMERICAN GAS ASSOCIATION PROCEEDINGS, 1929. Published by the Association, 420 Lexington Avenue, New York City. 1,342 pages—This volume contains the technical and commercial papers presented at the eleventh annual convention of the association, held in Atlantic City, Oct., 1929.

THE USE OF THE MICROSCOPE. By *John Belling*. McGraw-Hill Book Company, New York, 1930. 307 pages. Price $4.—Structure, theory, and manipulation of microscopes are described at length for students and prospective users in chemical, biological, and similar fields. The content, however, is considerably reduced because chapters were independently assembled and hence repeat a good deal.

SELECTIONS FROM RECENT LITERATURE

AUTOCLAVES. A. W. C. Harrison. *Industrial Chemist,* May, pp. 185-8. A practical discussion is presented of the design, installation and operation of simple types of autoclaves, including plain, steam-jacketed, oil-jacketed, fusible metal-jacketed, and special tubular or revolving drum autoclaves. Jacketed autoclaves tend to give somewhat better yields and purer product than the direct-heat type; but with intelligent design and operation, there is considerable economy in the use of direct-heated autoclaves. Tough mild steel is especially suitable for making large jacketed autoclaves, unless a lead or vitreous lining is required or some other consideration compels the use of castings. In the matter of design, attention is given to such details as lid thickness, making gas-tight joints, proper attachment of charging-hole covers, fitting of stirrers, blow-off orifice contour, shaft lubrication, weight of stirrer and shaft, and suitable drives for high- and low-temperature work. Considerations involved in choosing the optimum rate of stirring are stated. Owing to the relatively large possibilities of damage in case the stirrer stops, a silent chain drive is considered safer, because less liable to slip than a belt drive. Packing rings and disks and stirrer packing glands are discussed in detail, with emphasis on their importance in making and keeping the apparatus gas-tight. Particular attention is given to the use of autoclaves in the manufacture of dye intermediates.

FRACTIONATING COLUMNS. Emil Kirschbaum. *Chemische Apparatur,* May 10, pp. 97-8. As a means of lessening the necessary height of columns for rectifying alcohol and the like, a system of flat-bottomed trays has been tried instead of the conventional bell-bottomed trays. The comparison is made on the basis of working efficiency of the column, defined as the ratio of number of trays actually required for a given concentrating effect to the number required by theory. For experimental comparison a column was used which was about 4½ in. in diameter and was fitted with 35 flat trays, spaced at intervals of about ⅓ in. The result, rectifying dilute alcohol, was unfavorable to the flat-tray construction. Careful comparison of the two types of columns reveals that the reason is simply a matter of contact surface between the liquid and vapor phases. In the bell-bottomed trays the liquid, in falling from tray to tray, has enough distance to fall so that the liquid film breaks into a spray. With the much closer spacing of flat trays this does not occur, and a relatively large proportion of the vapor space is wasted in so far as contact is concerned. The result is that any saving in height of columns by using flat trays must be compensated by an increase in diameter, so that the advantage is lost. To obtain the best effect with flat trays, they would need to be finely perforated or otherwise adapted to give large contact surface between vapor and liquid.

GRINDING WHEEL FOR PULP. E. Bock. *Wochenblatt für Papierfabrikation,* May 3, pp. 575-8. It has been observed recently that tensile strength tests of natural grinding stone show considerably higher strengths than were observed in similar tests made in 1911 and 1912. This is attributed partly to improved quality of output from the sandstone quarries, and partly to use of sampling devices having relatively little effect on the stone. Tests with air-dried and water-soaked stones showed about the same tensile figures (16.9 and 16.7 kg. per square centimeter, respectively): but samples impregnated with a hardened binder gave much higher figures (average 60.9 kg. per square centimeter). Impregnation with a binder which holds the quartz grains too firmly in place is to be avoided, because worn grains are then held in the stone long after their cutting edges are rounded off. A water-soluble binder should be used, so that in wet grinding the surface of the stone (being kept wet) will not hold its quartz grains too firmly. Modern grinding speeds are such, in pulp grinding at least, that the tangential stresses approach dangerously close to the elastic limit of untreated stones. Proper impregnation with a suitable binder greatly increases the elastic limit, so that higher peripheral speeds become safe. Even if what is now considered the highest permissible speed for untreated stones should be accidentally doubled—e. g., by allowing the stone to run idle—the tangential stress (although now multiplied 4 times) would still be well within the safe limits for a properly impregnated stone.

DUST CONTROL. Theodore Hatch, Philip Drinker and Sarah P. Choate. *Journal of Industrial Hygiene,* March, pp. 75-91. The silicosis hazard in the hard-rock industries has been considerably magnified by the use of high-speed pneumatic tools for cutting and working granite and other stone. The distance of the breathing plane above the stone is about 12 to 15 in. in four-pointing, 15 in. in rough chiseling, 12 to 15 in. in split-chisel surfacing, 8 to 10 in. in lettering, and 6 in. in carving designs. These figures apply to the use of modern pneumatic machines for these operations. On account of the localized dust source and these short distances from the breathing zone, general ventilation is not adequate, and some other means of dust control must be provided. With this background, a study was made of the fundamental engineering principles involved in providing adequate dust control for pneumatic stone-cutting tools and surfacing machines. Minimum air velocities required to keep the dust concentration within permissible limits were determined for various hood shapes, and a system of local exhaust ventilation was worked out on this basis. The hood design which gave best results was one in which the hammer of the machine is inclosed by the hood through a half circle, inclosure being completed by a narrow band adapted to deflect particles thrown off at a small angle from the stone. This band also increases air velocity by blocking off part of the opening. The air-flow requirement is about 315 cu.ft. per minute for a small surfacing machine, and more for larger machines.

LIGHT METALS IN TEXTILE MACHINERY. Ernst Blau. *Melliand Textilberichte,* April, pp. 331-2. Of the light metal alloys, as a means of decreasing dead weight and improving workability or other properties of metal for machine parts, alloys of aluminum are much used in the textile industry, but magnesium alloys are not. Light alloy castings are much in use, with preference for sand castings when few like pieces are to be made, mold castings for quantity production of medium or large pieces, and spray castings for quantity production of small pieces. One of the leading alloys for textile machinery is Silumin (known in France and England as Alpax). Its casting properties permit use of thinner walled pieces than with any other alloy. Silumin has been successfully adapted to production of housings, bearings, pulleys, brake drums, fan blades, bleaching and dyeing apparatus, perforated tubes, washing machine parts, and the like. By suitable heat treatments or mechanical working, tensile strength and other mechanical properties of Silumin and like alloys can be greatly improved. There still remain numerous opportunities in the textile industry for replacement of iron or steel with light alloys such as Silumin, Lautal, and the like.

WOOD DISTILLATION EQUIPMENT. J. Schwyzer. *Chemiker-Zeitung,* Jan. 22, pp. 65-6; Jan. 29, pp. 86-7. Production costs in a wood distillation enterprise have been considerably lowered by a program of thorough modernization of equipment. An improved triple-still system, larger capacity retorts, and new designs in apparatus for refining wood spirit, fractionating distillates, and decomposing gray acetate contributed toward noteworthy economies in labor, plant maintenance, and fuel. A description is given of a plant thus modernized, designed for a capacity of about 60,000 cu.m. of wood per year. This plant requires 10 retorts of 175

cu.m. capacity. The design of these retorts, and of the masonry with which they are built in, is described and illustrated. They are sturdily built for long life in severe service, and arranged for ease of charging and discharging. Producer gas is supplied to the retort heaters from a producer using about 6 to 8 tons of coal per day. The operating cycle for a retort is about 3½ to 4 days for distillation, 3 to 3½ days for cooling, and 1½ days for discharging and cleaning out the retort.

WEAR-RESISTING WELDS. Karl Tewes. *Chemisch - metallurgische Zeitschrift*, May 3, pp. 985-6. In the application of arc welding to restoration of worn plant equipment, developments in electrode composition have lagged behind welding-machine design, training of skilled welders, and other aspects of the art. It is possible not only to restore but to improve upon the original wear-resistance of a piece of equipment; and since wear resistance is largely a matter of surface hardness, it is important to use welding rods made of an alloy which will impart hardness to the repaired surface. In this respect welds for restoring worn parts differ from ordinary joining welds, for which a soft, relatively pure, low-carbon iron is suitable. A restoration weld, on the other hand, requires a high-carbon alloy steel, which greatly complicates the welding procedure, because of the much greater difficulty of preventing gas inclusions in the weld. To counteract the gas-retaining influence of the rapid cooling of the melt, a deoxidizing agent is often used; e. g., aluminum, silicon, or manganese. Instead of surrounding the weld with this agent, as is customary, the procedure is simplified if the deoxidizing agent is directly alloyed with the welding rod. Titanium is especially suitable for such an alloy constituent, because its marked affinity for nitrogen helps greatly to increase the hardness of the weld. Even as small an increase as 0.1 per cent in the nitrogen content gives a notable increase in hardness.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Mineral production statistics for 1929—preliminary mimeographed statements from Bureau of Mines on: Talc; pyrites; aluminum salts; asbestos; masonry, natural, and puzzolan cements; salt, bromine, and calcium chloride; graphite; iron and steel; copper; refined primary lead; and manganese.

Mineral production statistics for 1928—separate pamphlets from Bureau of Mines on: Cement, by B. W. Bagley, 10 cents; Asphalt and Related Bitumens, by A. H. Redfield, 10 cents; and Coal, by F. G. Tryon and others. 30 cents.

Denaturation of Ethyl Acetate. Treasury Decision 53, issued by the office of the Commissioner of Prohibition, approved April 28, 1930, with Circular Letter 569 of the Bureau addressed to prohibition administrators and others concerned; mimeographed.

Bismuth. Bureau of Standards Circular 382; 10 cents.

Construction and Operation of the Bureau of Mines Experimental Oil-Shale Plant, 1925-1927, by Martin J. Gavin and John S. Desmond. Bureau of Mines Bulletin 315; 70 cents.

Petroleum Refineries in the United States, Jan. 1, 1930, by G. R. Hopkins and E. W. Cochrane. Bureau of Mines Information Circular 6292; mimeographed.

Apparatus for Vacuum Distillation of Lubricating and Heavy Petroleum Oils, by Martin J. Gavin and Arch L. Foster. Bureau of Mines Report of Investigations 2996; mimeographed.

Toxicity of Dichloro-Difluoro Methane: A New Refrigerant, by R. R. Sayers and others. Bureau of Mines Report of Investigations 3013; mimeographed.

Petroleum Coke—An Economic Survey of Its Production and Uses, by E. B. Swanson. Bureau of Mines Economic Paper 9; 10 cents.

German Chemical Developments in 1929, by William T. Daugherty, American Trade Commissioner, Berlin. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 690; 10 cents.

International Trade in Mica, by Joseph Ulmer. Bureau of Foreign and Domestic Commerce Trade Promotion Series 95; 15 cents.

Treated Lumber, Its Uses and Economies. Report of Subcommittee of the National Committee on Wood Utilization on Retail Distribution of Treated Lumber; 15 cents.

Manufacture and Properties of a Cellulose Product (Maizolith) From Cornstalks and Corncobs, by C. E. Hartford. Bureau of Standards Miscellaneous Publication 108; 5 cents.

Chemistry and Analysis of the Permitted Coal-Tar Food Dyes Ponceau SX, Sunset Yellow FCF, and Brilliant Blue FCF, by O. L. Evenson and H. T. Herrick. Supplement No. 1 to U. S. Department of Agriculture Department Bulletin 1390; 5 cents.

Commercial Standards. Two documents issued by the Bureau of Standards as follows: Certification Plan, Significance and Scope—Its Application to Federal Specifications and Commercial Standards, issued as Miscellaneous Publication 105; and The Commercial Standards Service and its Value to Business, issued as Commercial Standard CSO-30 under the program for elimination of waste through simplified commercial practice, 10 cents.

Code for Identification of Gas-Mask Canisters, sponsored by National Safety Council. Bureau of Labor Statistics Bulletin 512; 5 cents.

Ignition of Natural Gas-Air Mixtures by Heated Surfaces, by P. G. Guest. Bureau of Mines Technical Paper 475; 20 cents.

Miscellaneous Publications

Warning Agents for Methyl Chloride in Refrigeration. The Roessler & Hasslacher Chemical Company, New York. 31 pages. Report of research and conclusions.

Present State of Cylinder Testing. By F. Eder, Robert W. Hunt Company, Chicago. Reprint of paper presented before Compressed Gas Manufacturers Association.

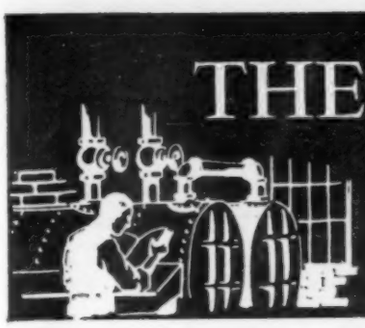
Colorimeter Issue of *Instruments*, February, 1930. Published at 1117 Wolfendale Street, Pittsburgh, Pa. 50 cents.

Corrosion in the American Oil Industry. By Gustav Egloff. Universal Oil Products Company, Chicago. 78 pages. Presented at the World Engineering Congress, Tokyo, Japan, November, 1929.

Developed and Undeveloped Resources of Wyoming. By C. S. Dietz. Wyoming Geological Survey, Cheyenne, Wyo. 194 pages. Price, $1. Compilation and evaluation of chemical and mining resources of the state.

Introduction to the Use of Beilstein's Handbuch der Organischen Chemie. By Ernest Hamlin Huntress. John Wiley & Sons, Inc., New York, 1930. 35 pages. Price, $1. To facilitate the use of the "organic chemist's Bible."

The Carnegie Institute of Technology has recently issued two co-operative bulletins of the U. S. Bureau of Mines, the Carnegie Institute, and the Mining and Metallurgical Advisory Boards. These bulletins, which are listed below, are available by purchase from John D. Beatty, Carnegie Institute of Technology, Pittsburgh, Pa., at the prices indicated: The Physical Chemistry of Steel-Making: Deoxidation With Silicon in the Basic Open-Hearth Process, by C. H. Herty, Jr., C. F. Christopher, and R. W. Stewart; Co-operative Bulletin 38; price, $2. The Physical Chemistry of Steel-Making: Deoxidation of Steel With Aluminum, by C. H. Herty, Jr., G. R. Fitterer, and J. M. Byrns. Co-operative Bulletin 46; price, $1.



THE PLANT NOTEBOOK

Revivification of Foam Solutions for Fire Protection With CO_2

By C. B. White
Chemical Engineer
American-La France & Foamite Industries
Elmira, N. Y.

EXTINGUISHING oil fires by the foam method is too well known to need a lengthy description. It is sufficient merely to point out that two solutions are used and that when they are brought together they form a tough, durable foam, the bubbles of which are filled with carbon dioxide.

It is not the purpose of this article to discuss the relative merits of the various formulas which have been employed in making up the two solutions. Suffice it to say that the bases of all such solutions are aluminum sulphate for one solution, and sodium bicarbonate for the other. To one or both of these solutions is added a foaming agent, colloidal in nature and usually of vegetable origin.

It is with the soda solution that we are particularly concerned in this article. This, as a rule, contains 8 per cent sodium bicarbonate when freshly made, but in common with any sodium bicarbonate solution kept in unsealed containers, it slowly breaks down, losing carbon dioxide and forming normal sodium carbonate, according to the equation

$$2NaHCO_3 \rightleftarrows Na_2CO_3 + CO_2 + H_2O.$$

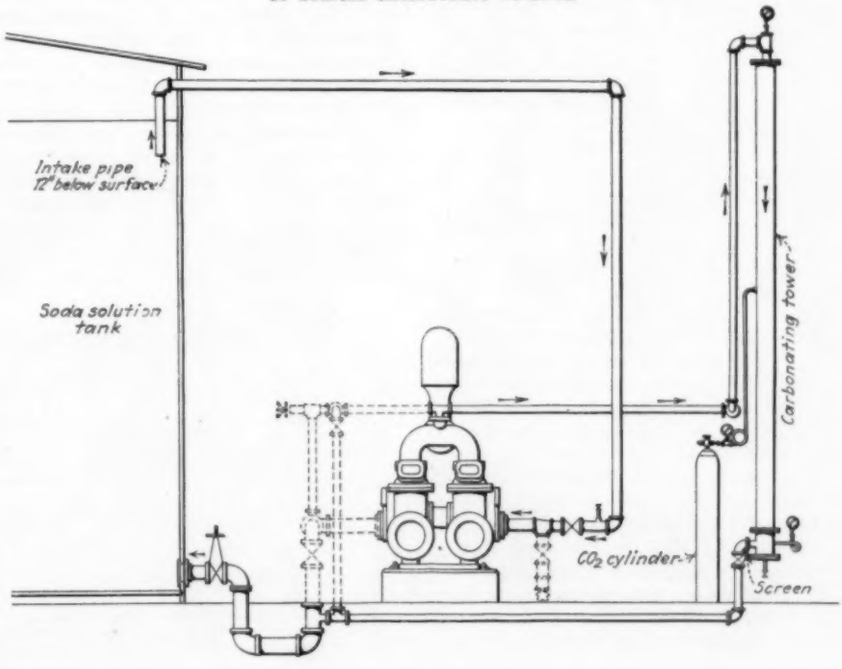
In practically sealed tanks such as are used in connection with foam-type chemical engines and extinguishers, this action is negligible. This, no doubt, is due to the carbon-dioxide balance which is established in such cases. In the larger installations of 50,000 gal. and 100,000 gal. of soda solution, where unsealed tanks are almost universally used, the useful life of a soda solution may be only a few years, depending upon temperature conditions and the general care given it. Sealed tanks which will automatically vent in fire emergency are not used today with any reasonable degree of success.

WHEN A SODA SOLUTION has broken down to a certain point it will no longer produce a quantity and quality of foam sufficient to meet the rather exacting demands for fire protection. (See "Testing of Foam for Use on Fires," by Clement K. Swift, *Ind. Eng. Chem.*, June, 1924.) At this point the solution has, in the past, been discarded and a new one made up to replace it. Since in the average foam system the soda solution is represented by 100,000 gal., several days has of necessity had to elapse while the new solution was being made up, during which the system was not available for fighting fires. The expense of recharging ran into fairly large figures. To be sure, this represented a rather small insurance premium when the type and value of the risk was considered. But it has long been evident that if some economical means of reviving soda solutions could be devised, the discovery would meet with instant approval among users of foam systems.

A suggestion most frequently made was that, as the sodium bicarbonate content decreased and the normal carbonate content increased, it should be possible to add more bicarbonate to keep the percentage at or near the proper figure. This method was practiced in a few cases, and within narrow limits it proved more or less successful. It was, however, unscientific and cumbersome, and in the long run the practice proved to be uneconomical. In the first place, dissolving the salt in a solution containing the colloidal foaming agent was attended with some difficulty. Second, it should be borne in mind that the addition of more sodium bicarbonate to the soda solution entailed the addition of a proportionate quantity of aluminum sulphate to the other solution to take care of the additional basic material.

IT WAS READILY conceded that eventually the limit to which bicarbonate might be added to the soda solution would have been reached and the solution would then have to be discarded. This would leave the owner of the system with an acid solution of too great a strength to be used with a new

Diagrammatic Arrangement of Pump and CO_2 Tower for Revivification of Sodium Bicarbonate Solution



soda solution. The acid solution would then have to be diluted to conform, and, since the tanks are kept full, this usually would mean that some of the aluminum sulphate solution must be discarded to allow for dilution. Thus the owner would lose his original bicarbonate, all of the bicarbonate added during the life of the solution, the aluminum sulphate it was necessary to add to match the increase in total alkali, and much labor.

A much better method is to supply that which has been lost, viz., the CO_2. It will be noted that the equation given above for the breaking down of the sodium bicarbonate is reversible: Normal sodium carbonate in solution when treated with CO_2 will produce $NaHCO_3$.

Laboratory experiments indicated that bubbling CO_2 through a sample of worn-out soda solution would completely restore it to its original condition so far as its bicarbonate content was concerned, but that the expense of doing this on a large scale would be high, due to the inefficient and wasteful method of introducing the gas only a part of which was taken up.

Necessity for the development of a suitable apparatus by which the absorption of the gas might take place under pressure became apparent. The present form of this device is shown diagrammatically in the accompanying drawing. Briefly, the soda solution is drafted from the top of the storage tank by the regular system pump, and then discharged into the top of a tower. The tower is usually filled with pieces of chemical stoneware, or even brickbats, and is provided with a suitable screen at the outlet. About half-way up the tower a connection is provided by means of which the CO_2 gas may be introduced from commercial CO_2 cylinders. From the bottom of the tower the solution travels through what is normally known as the "tank suction line" to the bottom of the soda solution tank.

THIS ARRANGEMENT avoids the use of any additional pump and, more important still, it leaves the entire system available for fire fighting at a moment's notice, by merely manipulating the appropriate valves.

Carbon dioxide is admitted as rapidly as possible without loss of gas. Any such loss is indicated by excessive bubbling on the surface of the soda solution in its storage tank.

The best working conditions for this revivification vary more or less with different systems, but in general they may be summed up as follows:

1. Pump speed 6 to 9 r.p.m., with water circulating in the acid end.
2. Pressure at CO_2 inlet 40 to 60 lb.
3. Rate of application of CO_2, 2 to 3 lb. per minute.

This means that with about 100 gal. of soda solution per minute passing through the tower, between 2 and 3 lb. per minute of CO_2 is absorbed if the pressure is regulated at 40 to 60 lb.

In conclusion, a word of warning: this revivification process is not a panacea for everything. It will not correct such faults as improper mixing of the soda solution, the use of impure water, or the faults incident to the use of an inferior foaming agent. It will not materially improve the quality of a soda solution contaminated with oil. It *will* restore the bicarbonate to properly made solutions which have become poor by reason of ageing and loss of CO_2.

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Accurately Adjustable Gravity Separator

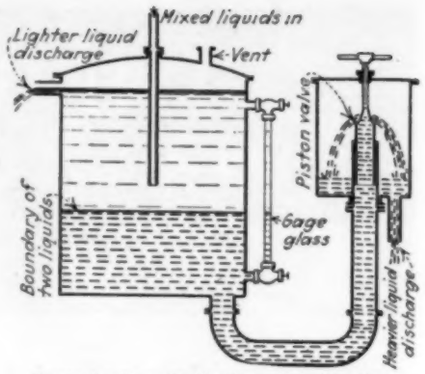
By D. F. Othmer
Eastman Kodak Company, Rochester, N. Y.

FREQUENTLY in distillation, extraction, and liquid washing or treating systems it is necessary to decant liquids of different specific gravities. An accompanying sketch shows a convenient gravity separator which may be readily adjusted to separate various pairs of immiscible liquids. The ratio of the quantities of heavier and lighter liquid held in the apparatus may also be varied to adjust for different rates of settling or to maintain a greater or lesser quantity of one or the other in storage.

Any mixture of two immiscible liquids of different specific gravities is introduced into the main settling tank well below the top of the upper layer of solution. This tank is vented and has suitable baffles, if desired to assist the settling action. Clear liquid of lower specific gravity is discharged from the overflow. The heavier liquid passes from the underflow to the small surge tank from which it is discharged. A vertical piston valve regulates the flow of the heavier liquid and therefore its level in the main tank.

The piston is a length of pipe of suitable size with a "spider" or other arrangement to permit attachment to a threaded stem. A handle or wheel fitted to this stem serves to raise or lower the piston and thus regulate the effective head of the heavier liquid. Obviously, a series of draw-off valves on this central standpipe, or an arrangement such as a flexible hose or swing pipe joint would serve the same purpose but would not permit as nice control.

An absolutely tight joint between the plunger and its sleeve is unnecessary for continuous use. If the inner tube is made of sufficiently heavy material, with a welded seam, it may be machined so as to barely slide in a larger drawn tube. For intermittent use, where the installation of a standard valve between the settling and surge tanks is undesirable, this plunger valve may be made tight by a suitably designed packing gland.



Cross-Section Indicating Construction of Gravity Separator

In many cases, if one or the other of the liquids runs directly to the suction of a centrifugal pump for discharge elsewhere, it is quite possible that air may enter the suction line and cause some difficulty. If one of the liquids happens to be a volatile solvent, this entrainment of air may involve not only an explosive mixture in the pipe lines but also a considerable loss of solvent by volatilization. A float valve may be conveniently placed in the surge tank or in the main settling tank to throttle either the heavier or the lighter liquid outflow and thus maintain a full stream without air entrainment. A similar float arrangement may be used instead, to regulate steam to a reciprocating pump or a turbine driven centrifugal.

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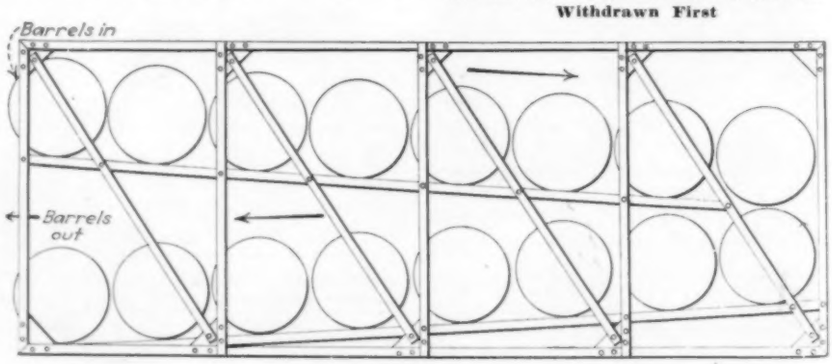
Use Older Barrels First

By Louis E. Brunner
Operating Chemist
Watseka, Ill.

PLANTS which buy materials in barrels or drums can use a very simple device to make sure that old stock will be withdrawn first from storage. This is shown in the drawing below to consist of a rack with sloping tracks onto which the barrels are loaded at the top and from which they are withdrawn at the bottom.

A Wood or Steel Rack of This Type Makes Sure That Old Barrels Will Be Withdrawn First



EQUIPMENT NEWS
FROM MAKER AND USER

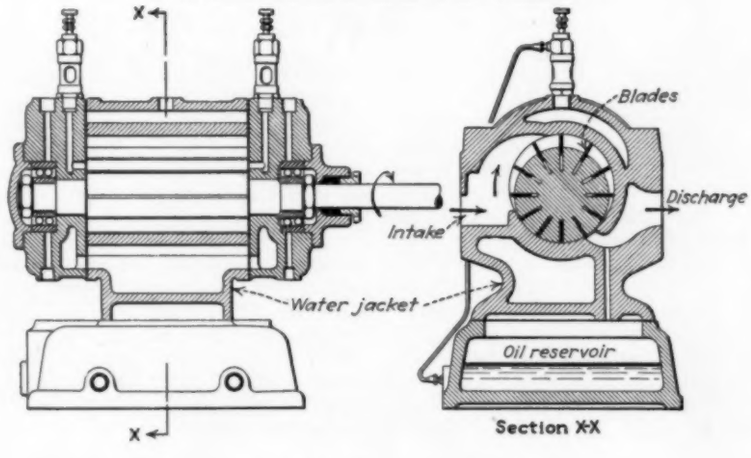
Rotary Compressor

NEW to the American market, the Fuller Company, Catasauqua, Pa., has announced a line of rotary compressors and vacuum pumps which have previously been successfully developed in France. Reference to the end and side views of a single-stage compressor in the accompanying drawing will indicate the principle of this pump. It consists of a water-jacketed casing, containing a cylindrical bore in which a rotor is mounted. A number of milled radial grooves are provided in the rotor in which blades of special alloy steel slide freely. As the rotor revolves, centrifugal force holds the blade ends against the cylindrical bore of the casing. Thus, air or other gas is trapped between the blades and the casing and is carried, while being compressed, to the discharge port. A special shaping of the edge of the blade in contact with the casing is said to result in decreased wear and to insure the maintenance of a film of oil at all times between the blades and the casing.

Single-stage units are available for capacities up to 3,500 cu.ft. per minute and pressures up to 55-lb. gage. Two-stage compressors are available for the same capacity, for pressures from 55-lb. to 170-lb. gage. In smaller two-stage compressors, an inter-cooler is mounted in the base, while a separate inter-cooler is provided in the larger sizes. Lubrication of compressors is insured by the forced feeding of oil to grooves in the ends of the rotor, from which the lubricant passes into the bases of the slots, moving outward by centrifugal force on both sides of the blades.

With slight changes in this machine, it is supplied as a vacuum pump in capacities up to 3,500 cu.ft. per minute for vacuum as high as 29½ in. According to the manufacturer, this type of compressor or vacuum pump offers the advantages of steady flow of air, reduction in wear, and extreme compactness. It may also be directly connected to motors without the use of belts or reduction gearing.

Sectional View of New Single-Stage Rotary Compressor Showing Movable Blades in Contact With Casing



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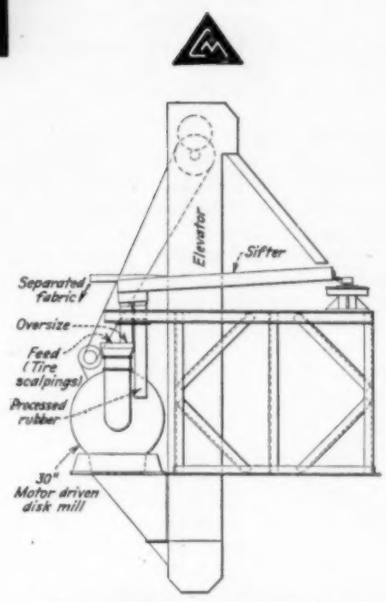
Rubber-Reclaiming Equipment

RUBBER RECLAMATION has occupied an increasingly important place in industry during the past few years. Coincident with this increase in interest in reclaimed rubber, much effort has been expended in the development of new methods for carrying out the process. Both chemical and mechanical methods are represented among these developments.

The Robinson Manufacturing Company, Muncy, Pa., has recently completed development of a mechanical process which is claimed to yield a good product at low reclaiming cost. It is pointed out that most earlier mechanical processes have been relatively unsuccessful, due to the generation of considerable heat in the grinding operation. In the new Robinson process, one of the company's standard single-runner disk mills is modified with special grinding plates, and close-circuited with a modified form of the company's "Gyro-Sifter." The mill is fed with pieces of tire which have been stripped off and run through cracking rolls.

The action of the modified disks is claimed to grind the rubber but to have little effect upon the fabric. Output of the mill is then elevated to the sifter, which makes use of a special "tailing baffle" so that three separations are possible. The finely ground rubber passes through the screen; the fabric and coarse rubber pass over the screen to the "tailing baffle"; the coarse rubber passes under the edge of the latter; and the fabric passes up on the baffle, where the few remaining particles of rubber are shaken free from the fabric and dropped down through the baffle.



Mill, Elevator and Screen for Reclaiming Rubber

Coarse rubber is sent back to the grinder by gravity, while the fine rubber may be sent to the calender rolls.

The drawing shows a layout capable of reclaiming from 1,000 to 1,500 lb. of scrap rubber per hour. Tests have shown that a rate of 20 lb. per horsepower-hour can be maintained if the rubber is dampened prior to grinding. Dampening has improved the grinding, according to the manufacturer, while the heat of grinding dries the rubber in the mill.

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Gas Detector

A DEVELOPMENT of D. W. Jones, explosive chemist for the U. S. Bureau of Mines, is being marketed under the name of the Jones gas detector by the Mine Safety Appliances Company, Pittsburgh, Pa. The detector is designed to give either the approximate explosive content or the oxygen deficiency of atmospheres in confined spaces. It may be used with such gases as illuminating and natural gas, blast-furnace gas, carbon monoxide, hydrogen, gasoline, naphtha, cleaning compounds, etc.

It consists essentially of a bomb in which a spark plug is inserted and to which a pressure gage is attached. It also includes a measuring device, a

cylinder of propane, an aspirator bulb, dry cells, a spark coil, switches, valves, etc. It is stated that the propane, which is used as a reference gas, is used in such small quantity that a single small cylinder will suffice for approximately 300 tests.

In operation, a sample of gas is forced into the apparatus by means of the aspirator bulb. The bomb is then closed off and the spark discharged. An explosion is indicated on the pressure gage. If no explosion is indicated, a measured amount of propane is added to the gas in quantity sufficient to produce an explosion. If no explosion is obtained through the use of the propane, a new sample of gas is taken and diluted with air until an explosion takes place. The quantity of air required indicates the deficiency of oxygen in the original sample.

This detector is easily portable, weighing only 26 lb., while its largest dimension is 19 in.

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Unique Conveyor

SCREW CONVEYORS in the past have been adaptable only to the handling of bulk materials. Through a new application of the screw principle, packages—principally in the form of bags, bales, barrels and cases—may be handled to and from storage, anywhere in the plant, at the will of the operator, by means of the new "TwinVeyor" made by the Clark Tructractor Company, Battle Creek, Mich. This machine is best explained in conjunction with the accompanying photograph which shows bags being handled at the rate of 1,800 per hour in a large sugar refinery.

The conveyor consists of a motor and power head which drives two spiral tubes upon the surface of which are spiral beads for advancing the packages. The tubes are driven in opposite direction and move the packages at the rate of 90 ft. per minute. For ease in handling, each tube is 8 ft. long, and is coupled to the next in the series at a bearing point which permits a flexibility of 15 deg. The conveyor is said to operate up a 30 per cent grade.

New Conveyor Stacking 1,800 Bags of Sugar Per Hour in a Large Sugar Refinery

The manufacturer claims that one of the principal features of this conveyor is its easy portability. Special supports for the bearing points are not necessary as is indicated in the photograph. Other features include flexibility of length and inclination, high speed and large capacity.

❖

Drive Equipment

LINK-BELT Company, 910 South Michigan Ave., Chicago, announces that complete roller-chain drives, including sprockets, are now carried in stock at various distributing points throughout the country. Silent chain drives have been handled in this manner for the past six years. The new move makes possible the procuring of either type of drive on short notice.

The H. W. Caldwell & Sons Company Division of Link-Belt Company also has announced the stocking of a new line of standardized elevator drive units. These drives are built to operate elevators requiring from 3 to 15 hp. and consist of two stages of reduction, the first stage being a fully inclosed worm-gear speed reducer to which a motor is coupled. The motor and the worm gear reducer are mounted upon a welded steel base. The second stage makes use of a roller chain engaging pinions on the worm gear shaft and the elevator head shaft. These drives are available in a wide range of reductions.

Another new development is a line of standardized drives for screw conveyors. These are available for conveyors having screws from 8 to 16 in. in diameter. The drive known as Type C uses two reductions. The motor, mounted on the conveyor trough, drives a worm-gear reducer through a silent chain, while the low-speed shaft of the reducer is connected directly to the screw. Type D uses only one reduction, the motor and worm-gear reducer being mounted as a unit upon a base plate. The reducer is then connected directly to the screw. Reducers use anti-friction bearings and are available for conveyor speeds from 45 to 125 r.p.m.

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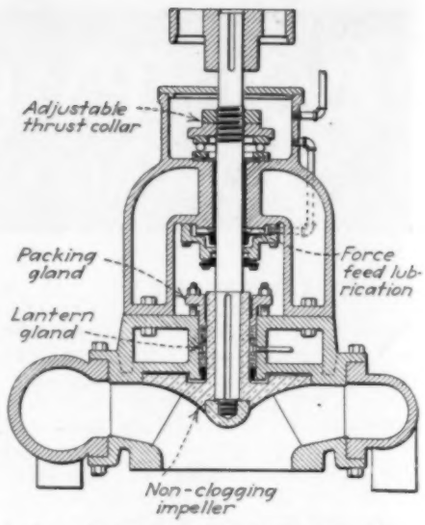
Non-Clogging Pumps

NON-CLOGGING features are emphasized in a new line of "Sureflo" vertical and horizontal centrifugal pumps recently placed on the market by the Lawrence Pump & Engine Company, Lawrence, Mass. The Type V.S.P. pump illustrated in the accompanying drawing is of vertical construction, built with removable top and bottom sections of the volute. The impeller is of the open type and has large passages, capable of passing large pieces of solid material. Impellers are made of bronze, cast iron, steel, or special alloys. Weight of the impeller is carried upon a ball-thrust bearing.

Type H.S.P. pumps are of horizontal construction with split casings or with solid volutes as desired. Pumps are mounted as a unit upon a base, direct-



Cross-Section of Vertical, Non-Clogging Centrifugal Pump

connected either to an electric motor or a gasoline engine. Two outboard ball bearings are provided.

Both styles of pump are available in sizes from 3-in. to 12-in. suction. These correspond to a normal capacity of 250 to 4,000 g.p.m. They are especially designed for use in such plants as paper mills, food plants, leather factories and sewage plants. The design makes possible the handling of thick stock, pulpy liquids, or liquids containing a large percentage of solids or stringy materials in suspension, according to the manufacturer.

❖

Electric Hoist

CAPACITIES ranging from ½ to 10 tons are available in a new line of electric hoists, announced by the Milwaukee Electric Crane & Hoist Corporation, Milwaukee, Wis. The hoist is said to be designed for high-speed operation, made possible by the use of roller bearings throughout. Forged gears, pinions, and wheels, and alloy steel shafts ground to size, are special features of these hoists. Additional features include push-button control, single or variable speed control, and oil bath lubrication for gears and brakes.

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Electrode for "18-8" Steels

WELDING of the "18-8" chrome-nickel steels is facilitated, according to the Lincoln Electric Company, Cleveland, Ohio, by a new welding electrode which this company is introducing under the name of "Stainweld A." It is claimed that welds made with this rod are of the same chemical composition as the steel itself, resulting in a dense, ductile weld. The rod is of the same chemical composition as the metal, and is covered with a coating which gassifies under the heat of the arc and is said to prevent oxidation of the weld metal. The rod is intended for use with reversed polarity and is obtainable in diameters of ⅛ in., 5/32 in. and 3/16 in.. and a length of 14 in.

Hand Lift Truck

A NEW light-duty lift truck of 2,500 lb. capacity, available in more than 120 standard stock models, is being produced by the Barrett-Cravens Company, 3250 West 30th Street, Chicago. This truck is marketed under the name of Barrett Red Junior. Its features include a

New Hand-Lift Truck for Loads up to 2,500 Lb.

spring handle holdup, a roller-bearing latch catch, an automatic engaging latch for lifting the load which eliminates necessity for stepping on a foot pedal prior to lifting the load, and Hyatt roller bearings with high-pressure lubrication.

U. S. Approves Mask

IT IS ANNOUNCED that the U. S. Bureau of Mines has given official approval to the combination hose mask manufactured by the Mine Safety Appliances Company, Pittsburgh, Pa. This mask, bearing approval number 1,901, is used to enter high concentrations of gas or oxygen-deficient atmospheres, the wearer being supplied with fresh air from the outside through hose up to 150 ft. in length.

Manufacturers' Latest Publications

Alundum. Norton Co., Worcester, Mass.—Bulletin briefly describing all products made by this company including alundum ware, refractories, porous plates, alundum tubes, pulp stones, abrasives, and grinding equipment.

Apparatus. Eimer & Amend, 3d Ave. and 18th St., New York, N. Y.—Bulletins describing water stills, laboratory motors and motor stirrers, comparators, carboy tilters, and viscosimeters.

Burners. Lee B. Mettler Co., 406 So. Main St., Los Angeles, Calif.—May, 1930, general catalog of entire line of gas and combination gas and oil burners made by this company.

Butane. Philfuels Co., General Motors Building, Detroit, Mich.—Booklet No. 1—25-page booklet describing completely the characteristics of commercial, liquefied petroleum gases, the methods of utilizing commercial butane as an industrial fuel and the conditions responsible for this fuel now being available in commercial quantities. The booklet also describes the transportation and storage of the fuel.

Centrifugals. Elmore Centrifugal Products Corp., 6527 Manchester Ave., St. Louis, Mo.—4-page folder describing the continuous centrifugal made by this company.

Chemicals. Mathieson Alkali Works, Inc., 250 Park Ave., New York, N. Y.—24-page booklet concerning a new product of this company, "true calcium hypochlorite," including development, properties and uses of this material.

Cleaning. Homestead Valve Mfg. Co., Coraopolis, Pa.—Folder describing "Hypressure Jenny," a unit device for heating and compressing and discharging cleaning compound under high pressure.

Combustion. Denver Fire Clay Co., Denver, Colo.—Bulletins 305 and 306—Describing respectively two forms of atmospheric gas burner made by this company.

Concrete. Pacatome, Ltd., Kohl Bldg., San Francisco, Calif.—Two bulletins describing the use of Pacatome diatomaceous silica in concrete.

Cork. Armstrong Cork Co., Lancaster, Pa.—48-page book entitled "Industrial Applications of Cork," fully describing properties of cork and listing several hundred uses.

Dilatometers. R. Y. Ferner Co., Investment Bldg., Washington, D. C.—Catalog D-1—Describes Chevenard industrial thermal analyzers and differential dilatometers for studying thermal expansion of metals and other materials.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-55B, round-pattern switchboard instruments; GEA-161E, Novalux floodlight projectors; GEA-189B, automatic switching equipment; GEA-246B, general-purpose synchronous motors; GEA-440C, turn-pull control switches; GEA-606B, 180-page industrial control catalog; GEA-735B, outdoor switching equipment; GEA-818A, price list of non-metallic gears and blanks; GEA-973A, drum controllers; GEA-1043A, Fabroil gears, price list; GEA-1062A, line contacts; GEA-1159A, trip-free circuit breakers; GEA-1195, synchronous motors; GEA-1238, vitreous-enameled resistors; GEA-1229, industrial haulage locomotives; GEA-1239, miniature instruments; GEA-1252, hatchway limit switches; GEB-80, metal-clad switch gear; GEC-81, industrial heating devices.

Electrical Equipment. Sangamo Electric Co., Springfield, Ill.—Bulletin 79—12 pages, describing type HC watt-hour meters. Also booklet of short discussions of this meter and seven-page booklet announcing a new electrically-wound time switch.

Electric Furnaces. Hevi Duty Electric Co., Milwaukee, Wisconsin—Bulletin 430—Six-page booklet covering 18 standard sizes of box-type electric furnaces; includes complete descriptions and specifications. Also Bulletin 530, four pages on pressure carburizing with rotary retort electric furnaces.

Equipment. Groen Mfg. Co., 4533 Armitage Ave., Chicago, Ill.—Folder showing types of equipment fabricated by this company.

Equipment. Hardinge Co., York, Pa.—Publications as follows: Ah-195, concerns economical drying by direct heat; Ah-199, describes Hardinge mills in a large metallurgical plant; Ah-200, gives performance on five different typical installations of Hardinge mills.

Equipment. Sullivan Machinery Co., 400 N. Michigan Ave., Chicago, Ill.—Bulletin 76-K—Leaflet describing a new line of anti-friction sheaves.

Filters. Mount Chemical Equipment Co., Lynchburg, Va.—Folder describing briefly the two principal types of rotary vacuum filter made by this company.

Filters. Oliver United Filters, Inc., 33 West 42d St., New York, N. Y.—Bulletin 201—31 pages, describing with illustrations the use of Oliver and American filters and savealls in the pulp and paper industry.

Gas Analysis. Hays Corp., Michigan City, Ind.—Catalog TSE 30—20-page booklet describing a new line of flue-gas analyzers and combustion test sets.

Gas-Burning Equipment. Partlow Corp., Utica, N. Y.—28-page catalog of gas-burning equipment made by this company, including pilots, temperature controllers, control valves, burners and blowers.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Instruction Book 214—Revised edition of electric flowmeter instruction book with detailed explanation of flow-measuring equipment made by this company, together with instructions for installing and adjusting this equipment.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 5301—Six-page folder regarding speed records and the graphic tachometers made by this company.

Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Folders describing various aspects of the recorders made by this company, including the recorder mechanism itself in its various uses, its use as a potentiometer pyrometer and the electrical balance inherent in the latter instrument.

Materials Handling. Chain Belt Co., Milwaukee, Wis.—Catalog 202—Catalog on bulk materials handling conveyors with engineering data and illustrations on elevators, bin gates, track hoppers and feeders, steel apron and pan conveyors, weigh larries and screw conveyors.

Materials Handling. Cleveland Electric Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio.—Four folders describing overhead handling with special applications of weighing and lift sections in miscellaneous industries.

Materials Handling. Palmer-Bee Co., Detroit, Mich.—Catalog 52—79-page catalog in two colors with many photographs and drawings illustrating the overhead and other types of chain-operated conveying equipment made by this company.

Mixers. Turbo-Mixer Corp., 250 East 43d St., New York, N. Y.—Folder describing Turbo-Mixing equipment for use in the petroleum industry, including contactors, blenders, treaters, and heat exchangers.

Power Transmission. Link-Belt Co., 300 West Pershing Rd., Chicago, Ill.—Folder 1223—8-page booklet describing the history and development of this company.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Bulletin 401—Handbook explaining the theory, characteristics, operation and installation of centrifugal pumps, compiled for this company by Prof. F. G. Switzer of Cornell University; 48 pages of very complete treatment including many illustrations.

Pumps. Yoemans Bros. Co., 1433 Dayton St., Chicago, Ill.—Bulletin HS-1200—12-page booklet, describing with engineering data, horizontally split-case centrifugal pumps made by this company.

Refrigeration. York Ice Machinery Corp., York, Pa.—Bulletin 3086—Describes in some detail self-contained refrigerating units; 16 pages. Bulletin 30159, oils for refrigerating machinery.

Rotating Furnace. Whiting Corp., Harvey, Ill.—Folder describing the new Brackelsberg rotating furnace for melting malleable iron, cast iron, and for special melting applications.

Safety. Metropolitan Life Insurance Co., 1 Madison Ave., New York—14-page booklet published by the Policyholders Service Bureau of this company in connection with a study of safety activities in the gas and electric utilities.

Safety. Metropolitan Life Insurance Co., New York, N. Y.—Industrial Safety Bulletin No. 6—"Safety Advertising," a 16-page booklet on methods of preparing and displaying safety advertising material.

Sodium Silicate. Philadelphia Quartz Co., 121 So. 3d St., Philadelphia, Pa.—12-page booklet summarizing advantages gained through use of silicate of soda in paper making as determined quantitatively by independent engineering surveys. Also leaflet describing adhesive properties of silicate of soda.

Steam Generation. Mears-Kane-Ofeldt, Inc., 1903 East Hagert St., Philadelphia, Pa.—Catalog Unit No. 4—Describes a new automatic boiler feed for high and low pressure boilers.

Temperature Control. Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago, Ill.—9-page article by S. E. Tomczak, sulphite superintendent of the Flambeau Paper Company, on "Temperature Control in Cooking Sulphite Pulp."

Thickening. Thyle Machinery Co., San Francisco, Calif.—Bulletin 60—12-page booklet completely describing the construction and use of the Bradley automatic density valve.

Valves. Worthington Pump and Machinery Corp., 2 Park Ave., New York.—Leaflet D-445-S-1—Describes an automatic stop valve of the flow type.

Water Purification. The Hagan Corp., Pittsburgh, Pa. Two booklets covering a new system of boiler water conditioning by means of "Hagan Phosphate," originally developed by the Hall Laboratories. These bulletins describe respectively the services of the Hall Laboratories and the Hagan Corp.; and the new conditioning method itself.

Water Supply. Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.—Bulletin 111.—20-page booklet describes equipment for pneumatic water supply systems.

Weighing. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.—"Beginning the Second Century," handsomely printed 20-page booklet commemorating the 100th anniversary of this company, summarizing briefly the company's activities in the fields of weighing and power generation and discussing present developments in weighing equipment.

"Welding Wire Research," practical in-Park Ave., New York—Booklet entitled "Welding Wire Research," practical information for welders on wire, testing welds, proper flame or current and testing wire.

PATENTS ISSUED

May 6 to May 27, 1930

Paper, Pulp, Glass and Sugar

Sheet Material and Method of Making. Albert E. H. Fair, Belmont, Mass., assignor to Arthur D. Little, Incorporated, Cambridge, Mass.—1,757,010.

Colloided Cellulose and Indurated Fiber. Frederick C. Hahn, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,757,755-7.

Method of Producing Cellulosic Material. Béla Dorner, Budapest, Hungary, assignor, by mesne assignments, to Cornstalk Products Company.—1,758,655.

Manufacture of Paper Pulp. Alfred M. Thomsen, San Francisco, Calif.—1,758,896.

Method and Apparatus for Producing Sheet Glass. John L. Drake, Toledo, Ohio, assignor to Libby-Owens Glass Company, Toledo, Ohio.—1,759,226-9.

Sheet-Glass Apparatus. Leopold Mambourg, Lancaster, Ohio, assignor to Libby-Owens Glass Company, Toledo, Ohio.—1,759,235-6.

Pulping Machine. George Stanford Witham, Jr., Hudson Falls, N. Y.—1,759,385.

Production of Cellulose Ester Compounds. Alonzo S. McDaniel, New York, N. Y., assignor to Cellulose Utilities Corporation.—1,759,489.

Apparatus for Feeding Molten Glass. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn.—1,760,254.

Rubber, Rayon, and Synthetic Plastics

Artificial Compositions Especially Those Resembling Rubber. Walter Frankenburger and Christian Steigerwald, Ludwigshafen, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,756,943.

Method of and Apparatus for Curing Rubber Articles by the Circulation of Heated Gases. Henry R. Minor, Ossining, N. Y., assignor, by mesne assignments, to Liquid Carbonic Corporation.—1,757,053.

Asphalt Emulsion. Arthur L. Halvorsen, New York, N. Y., and Pierce M. Travis, Ridgewood, N. J., assignors to Emulsion Process Corporation, Jersey City, N. J.—1,757,083.

Asphalt Emulsion. Pierce M. Travis, Ridgewood, and Arthur L. Halvorsen, Perth Amboy, N. J., assignors to Emulsion Process Corporation, Jersey City, N. J.—1,757,102.

Composition of Matter Comprising Resin Esters. Harry M. Weber, Newton, Mass., assignor to Ellis-Foster Company.—1,757,-104.

Process of Purifying Rosins. Robert C. Palmer, John L. Burda, and Anthony F. Oliver, Pensacola, Fla., assignors to Newport Company, Carrollville, Wis.—1,757,588.

Treatment of Latex. Eardley Hazell, New York, N. Y., assignor to Naugatuck Chemical Company, Naugatuck, Conn.—1,757,632.

Method of Vulcanizing Caoutchouc. Lorin B. Sebrell, Akron, Ohio, assignor to Goodyear Tire & Rubber Company, Akron, Ohio.—1,757,944.

Vulcanizable Plastic Composition. Norris Goodwin, Los Angeles, Calif., assignor, by mesne assignments, to Delano Land Company.—1,758,151.

Casein Containing Plastic Composition. William W. Christmas, Ridgefield Park, N. J., assignor of one-third to C. C. Hines, Washington, D. C.—1,758,500.

Paint and Varnish Remover and Process of Making Same. Carleton Ellis, Montclair, N. J., assignor to Chadeloid Chemical Company, New York, N. Y.—1,759,154.

Plastic Composition. Wolf Kritchevsky and Karl A. Schultz, Chicago, Ill.—1,759,907.

Petroleum Products and Technology

Method of Eliminating Colloidal Asphaltenes and Carbenes from Fuel Oil. Alphonsus Jurrissen, Martinez, Calif., assignor to Simplex Refining Company.—1,756,981.

Art of Pressure Distillation. Nathaniel E. Loomis, Elizabeth, N. J., assignor to Standard Oil Development Company.—1,757,579.

Process for Cracking Heavy Hydrocarbons to Produce Lighter Hydrocarbons and Coke. Harry L. Pelzer and Eugene C. Herthel, Chicago, Ill., assignors to Sinclair Refining Company, Chicago, Ill.—1,757,843.

Process for Producing Liquid Fuels. Alfred Joseph, Paris, France, assignor to Societe Internationale des Procedes Prudhomme Houdry, Paris, France.—1,758,796.

Art of Cracking Hydrocarbon Oils. John E. Bell, deceased, Brooklyn, N. Y., by Lola R. Bell, executrix, Brooklyn, N. Y., and Edward W. Isom, Locust Valley, N. Y., assignors to Sinclair Refining Company, New York, N. Y.—1,758,818.

Process of Purifying Hydrocarbons. John C. Black, Los Angeles, and John R. McConnell, Whittier, Calif., assignors, by mesne assignments, to Richfield Oil Company of California, Los Angeles, Calif.—1,759,730.

Process of Refining Hydrocarbon Oils. Earle W. Gard, Blair G. Aldridge, Hugh J. Multer, and Raymond T. Howes, Los Angeles County, Calif.—1,759,744.

Method for Purifying Hydrocarbon Compounds. Thomas T. Gray, Elizabeth, N. J., assignor to Gray Processes Corporation.—1,759,812-4.

Control of Pyrolytic Conversion. Frank A. Howard, Elizabeth, N. J., assignor to Standard Oil Development Company.—1,760,136.

Apparatus for Hydrolyzing Acid Sludge. Frank L. Maker and John L. Cooley, Berkeley, and Charles F. Tuttle, Richmond, Calif., assignors to Standard Oil Company of California, San Francisco, Calif.—1,760,-246.

Art of Cracking Hydrocarbon Oils. Eugene C. Herthel and Thomas De Colon Tifft, Chicago, Ill., assignors to Sinclair Refining Company, New York, N. Y.—1,760,357.

Oil-Cracking Still. Loftus B. Cuddy, Cleveland, Ohio.—1,760,400.

Process of Refining Hydrocarbons. Roy Cross, Kansas City, Mo., assignor to Cross Development Corporation.—1,760,585.

Coal and Organic Products

Coal-Carbonizing Apparatus for the Extraction of Bituminous Materials. Karl Bergfeld, Berlin, Germany.—1,756,969.

Tanning Preparation and Process. Ralph W. Frey, Mount Rainier, Md., assignor to the Government and the People of the United States of America.—1,757,040.

Manufacture of Aliphatic Chlor Compounds. Charles J. Strosacker, Midland, Mich., assignor to Dow Chemical Company, Midland, Mich.—1,757,100.

Method of Distilling Resinous Woods. John C. Schaffer, Pittsburgh, Pa., assignor to American Pine Products Corp., Reno, Nev.—1,757,144.

Gas Producer. Joseph Becker, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,757,232.

Sulphurized Compounds of Phenols. Alfred Thauss, Cologne-Deutz, Germany, assignor to General Aniline Works, Inc., New York, N. Y.—1,757,400.

Purification of Gaseous Mixtures. William J. Bannister, Terre Haute, Ind., assignor to Commercial Solvents Corporation, Terre Haute, Ind.—1,757,826.

Production of Ketones. Bruce K. Brown, Terre Haute, Ind., assignor to Commercial Solvents Corporation, Terre Haute, Ind.—1,757,830.

Process of Producing a Finely-Divided Carbon. Norris Goodwin, Long Beach, Calif., assignor, by mesne assignments, to Delano Land Company.—1,758,152.

Coking Retort. Hiram Teater, Cleveland, Ohio.—1,758,183.

Process of Producing Coke and Apparatus Therefor. Heinrich Koppers, Essen-Ruhr, Germany.—1,758,524.

Recuperative Coking Retort Oven. Joseph van Ackeren, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,758,544.

Process of Producing Urea. George Barsky, New York, N. Y., and Palmer W. Griffith, Elizabeth, N. J., assignors to American Cyanamid Company, New York, N. Y.—1,758,641.

Gas-Making Apparatus. Alfred Schwarz, Montclair, N. J., assignor to Coal & Oil Products Corporation.—1,758,858.

Method of Making Alcohol. Frank E. Lichtenthaeler, Newton Highlands, Mass.—1,759,122.

Apparatus for Producing Active Carbon. Johan Nicolaas Adolf Sauer, Amsterdam, Netherlands, deceased, assignor to Naamlooze Vennootschap Algemeene Norit Maatschappij, Amsterdam, Netherlands.—1,759,138.

Process for Refining Wood Spirit Oils. Wilhelm Qerfurth, Bruchhausen, Germany, assignor to Holzverkohlungs-Industrie Aktien-Gesellschaft, Konstanz, Germany.—1,759,369.

Method of Oxidizing Hydrocarbons Including Hydrocarbon Derivatives. Joseph Hidy James, Pittsburgh, Pa., assignor to Clarence P. Byrnes, trustee.—1,759,620.

Distillation of Tar. Alexander A. MacCubbin, Montclair, and Joseph Zavertnik, Jr., Harrington Park, N. J., assignors to Barrett Company, New York, N. Y.—1,759,816.

Process of Treating Oils and Other Glycerides. William C. Arsem, Schenectady, N. Y., assignor to General Electric Company.—1,760,535.

Highly-Active Adsorbent and Catalytic Mass. Fritz Stoewener, Ludwigshafen, and Ernst Münzing, Neurossen, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,760,289.

Process for the Removal of Benzol and Its Homologues from Fuel Gases. Joseph Becker, Pittsburgh, Pa., assignor to Koppers Company.—1,760,335.

Inorganic Processes

Process of Producing Hydrogen, John S. Beekley, Charleston, W. Va., assignor to Du Pont Ammonia Corporation, Wilmington, Del.—1,756,934.

Manufacture of Pure Lead Hydroxide Starting from Impure Sulphate of Lead. René Daloze, Uccle, Belgium.—1,757,902.

Process of Making Bleached White Barytes. William J. O'Brien, Baltimore, Md.—1,758,009.

Process for the Production of Phosphorus and Alumina Cement. Robert Suchy, Bitterfeld, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,758,241.

Chlorination. Charles L. Campbell, Boston, Mass., assignor to E. B. Badger & Sons Company, Boston, Mass.—1,758,351.

Method of Producing Ammonium Phosphate or Mixed Fertilizers Containing Ammonium Phosphate by Leaching of Raw Phosphate, Frans Georg Liljenroth, Stockholm, Sweden.—1,758,448.

Ammonium-Sulphate Manufacture. Frans G. Liljenroth, Stockholm, Sweden, assignor to Kunstdünger-Patent-Verwertungs-Aktiengesellschaft, Glarus, Switzerland.—1,-758,449.

Production of Titanic Oxide. Moritz Schnetka, Leverkusen-on-the-Rhine, Germany, assignor to Titanium Pigment Company, Inc., New York, N. Y.—1,758,472.

Production of Titanium Dioxide. Werner Mecklenburg, Moscow, Union of Soviet Socialist Republics.—1,758,528.

Process for Making Zinc Sulphide. Earl C. Gaskill, Red Bank, N. J.—1,758,741.

Manufacture of Lithopone. William C. Hooey, Palmerton, Pa., assignor to New Jersey Zinc Company, New York, N. Y.—1,756,115-6.

Process of Treating Natural Alkaline Waters or Brines to Obtain Therefrom Commercially Useful Substances. James G. Miller, Lone Pine, and Alexis C. Houghton, Bartlett, Calif.—1,759,361.

Method for Purifying Gas from Hydrogen Sulphide with Production of Zinc Sulphide. Albert F. Kunberger, Swarthmore, Pa., assignor to United Gas Improvement Company, Philadelphia, Pa.—1,759,408.

Blast Furnace for Reduction and Recovery of Volatilizable Metals as Oxides and Method of Operating the same. Wolfgang Job, Berlin-Dahlem, Germany, assignor to American Lurgi Corporation, New York, N. Y.—1,759,559.

Manufacture of Pure Iron. Alwin Mittasch, Ludwigshafen, Carl Müller, Mannheim, and Eduard Linckh, Ludwigshafen, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,759,658-61.

Production of Alkaline-Earth Titanates. Reginald Hill Monk and Uudvig Firing, Montreal, Quebec, Canada; said Firing assignor to John Irwin, Montreal, Canada.—1,760,513.

Process of Preparing Ammonia-Factor Gases. Francis H. Snyder and Edgar D. Newkirk, Syracuse, N. Y.—1,760,014.

Production of Chromates with Simultaneous Recovery of Alumina. Heinrich Specketer and Georg Henschel, Griesheim, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,760,788.

NEWS *of the* INDUSTRY

Fertilizer Association Re-elects Officers

TRADE practice code observance, better selling methods, and promotion of high-concentration and new types of fertilizer were considered in the two major round-table conferences at the National Fertilizer Association convention in Colorado Springs, June 9 to 12. These executive sessions of the convention afforded an opportunity for frank facing of price-cutting practices and the other difficulties which far-sighted members of the industry hope can be corrected by self-regulation.

The one general public session of the convention dealt with a number of the phases of the industry in which important changes are taking place. L. W. Rowell, of Swift & Company, president of the association, stressed "Change and Co-operation" in his annual presidential address. It was pointed out by Dr. David Francis Farrell, president of Kansas State Agricultural College, that even agriculture itself is not completely static. The evolutionary processes of agriculture in the United States, according to this agricultural leader, are operating at an accelerating rate which must be taken into account by those, like fertilizer manufacturers, whose business is intimately interrelated with agriculture. Accelerated soil depletion, rapid scientific readjustment, and a notable change in the attitude of people toward the conditions of agriculture are among the important considerations stressed. All of these contribute to new systems of soil management and the necessity for increased fertilizer use, both for maintenance of soil fertility and for labor saving.

Recent soil studies in the field of agronomy were reported to the convention by two speakers. New factors in fertilizer practice were outlined by Dr. Schreiner, of the U. S. Department of Agriculture, stressing among other considerations the changing types and the higher concentration now possible, due to engineering as well as scientific advance. The considerable phosphorous deficiency of the Colorado soils and the relations of fertilization and soil bacteria to this question were outlined by Dr. Walter G. Sackett, of the Colorado Agricultural Experiment Station. The convention banquet was addressed by former Assistant Secretary of Agriculture Colonel Clarence Ousley and Charles C. Concannon, chief of the chemical division of the Department of Commerce.

Officers of the association were re-elected and H. B. Baylor, Gustavus Ober, Jr., and A. C. Read were elected to the board of directors as directors at large. J. I. Morgan, P. H. Manire, and M. S. Purirs were elected to the board as representatives of their respective districts.

At the business session it was decided to reduce the assessment on bagged goods to 3½c. per ton. The rate formerly stood at 4c. per ton. Other assessments are to remain unchanged.

Alpha Chi Sigma Forms Professional Group

THIRTY or forty members of Alpha Chi Sigma, the professional chemical fraternity, residing in the New York area, have been meeting informally for the past few months and have decided to form an organized professional group. The meetings which have been held to date were primarily social rather than scientific and it is planned that during the summer months the group will conduct excursions to the beaches and other pleasant places in the vicinity. All members of Alpha Chi Sigma who have not received notices are invited to write to the president of the group, D. A. McLean, or the secretary, C. W. Borgmann, at the Bell Telephone Laboratories, 463 West Street, New York City.

Electrochemists Hold Annual Meeting

THE annual meeting of the American Electrochemical Society was held in St. Louis on May 29-31. A symposium on hydro-electrometallurgy was conducted by T. H. Donahue of East Chicago, Ind., and one on electrodeposition by Dr. Charles L. Mantell.

Louis Kaslenberg, professor of chemistry at the University of Wisconsin, was elected president.

Other officers elected were: vice-presidents, Bradley Stoughton, Hugh S. Taylor, and George M. Vinal; managers, D. A. Pritchard, M. R. Thompson, and Alexander Lowy; treasurer, Acheson Smith, and secretary, Colin G. Fink.

Statistical Service for Lime Association

AGGRESSIVE measures for promotion of the welfare of the lime industry are to be taken as a result of the annual convention of National Lime Association, held June 3 and 4 in Chicago. Much enlarged statistical service and some additions to the advertising campaign are contemplated. It is hoped that the statistical service will include a monthly résumé of production and of distribution by states or districts as well as by uses of lime. Attention is to be given to agricultural, construction, and "finishing" lime as well as to the applications of this material in chemical engineering industry. Both member and non-member companies will be asked to participate in the statistical service.

Somewhat over 50 per cent of the commercial lime production of the country is represented in the present membership of the association and a steady growth is being shown during the present year. The work of the association for the coming year will be directed by those officers who served during the past twelve months. Those re-elected were Norman G. Hough, president and general manager; Ralph P. Wilton, secretary-treasurer; and W. V. Brumbaugh, assistant secretary-treasurer.

Directors Named for Textile Foundation

THE bill incorporating the Textile Foundation to carry out research work for the textile industry was signed by the President on June 10. President Hoover has appointed as the first board of directors Franklin W. Hobbs, president of the Arlington Mills, Boston, and president of the National Association of Wool Manufacturers, for a term of four years: Stuart W. Cramer, president of the Cramerton Mills, Cramerton, N. C., for a term of three years, and Harry D. Thompson, president of the United States Finishing Company, New York, for a term of two years. The Secretary of Commerce and the Secretary of Agriculture are ex-officio members of the board. At an organization meeting Mr. Hobbs was chosen chairman of the board, and E. T. Pickard, chief of the textile division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, was named as acting secretary.

Jasper E. Crane Addresses Manufacturing Chemists

DEVELOPMENTS in the synthetic-ammonia industry that are rapidly making the United States self-supporting in nitrogen were described by Jasper E. Crane, chairman of the board of the Du Pont Ammonia Corporation, at the 48th annual meeting of the Manufacturing Chemists' Association of the United States, held at the Seaview Golf Club, Absecon, N. J., on June 5. Totaling 26,000 short tons in 1928 and 84,000 tons in 1929, the production of synthetic ammonia in 1930 was estimated by Mr. Crane at 148,000 tons of nitrogen.

Plant expansions now under way, said Mr. Crane, will bring the capacity for synthetic ammonia in 1931 up to 290,000 tons of nitrogen, placing the United States second only to Germany in rank among nitrogen-producing countries. Mr. Crane said that when this enlarged plant capacity is realized the American investment in synthetic-ammonia plants will aggregate $70,000,000, without taking into account plants for converting ammonia into other products. The addition of the increased production of synthetic ammonia to the production of byproduct ammonia, which, at 180,000 tons of nitrogen, is double that of any other country, is placing this country in a position, said Mr. Crane, where it will soon be independent of imported supplies.

Mr. Crane anticipates that the rate of increase in the consumption of nitrogen will not be quite as rapid as in the past few years but that there will be a gradual increase created by new uses. Mr. Crane pointed out that fertilizer nitrogen, depending on its form, is selling at prices from two-thirds to nine-tenths below 1913 figures. Declaring that cheap ammonia is just as significant in the chemical industry as cheap fertilizer in agriculture, Mr. Crane stated that ammonia now is the cheapest of all alkalis except lime; cheaper even than caustic soda, which sells at 2.9c. to 3.8c. per pound, while ammonia at 6c. is equal to caustic soda at 2.5c. per pound.

THE nitric-acid industry has been revolutionized, said Mr. Crane, by the American process of making this acid by oxidation of ammonia. He stated that manufacturers in several European countries have been licensed to use this process. Manufacture of nitrate of soda from synthetic ammonia is being carried on in this country on a huge scale, said Mr. Crane. He also stated that the addition of ammonia to superphosphate, neutralizing its acidity, and adding nitrogen, has taken hold very rapidly and is being practiced by all large fertilizer manufacturers. Mr. Crane expressed the belief that in mixed fertilizers a ratio of five parts of nitrogen, ten of P_2O_5, and five parts of K_2O would be more efficient than the ratio of 4:10:5 predominating at present.

Injection of synthetic ammonia into pipe lines to reduce corrosion of the pipes and in oil refineries for neutralizing traces of acid which remain in the oil after the acid treatment, were among the new uses for synthetic ammonia referred to by Mr. Crane. The use of ammonia in treating water in combination with chlorine is just beginning. If ammonia is added to the chlorine, forming chloramine, the quantity of chlorine necessary, said Mr. Crane, is reduced to about 40 per cent of the usual standard and the bactericidal action is increased. Mr. Crane noted that chloramine-treated water has no unpleasant taste.

The use of ammonia as a source of supply of hydrogen or nitrogen was described by Mr. Crane. Simple equipment has been designed for cracking ammonia, and at present prices, he said, the cost of cracked ammonia is just half that of hydrogen in cylinders. Cracked ammonia is suitable for use in all the standard kinds of welding, both torch and shielded arc. Another use for ammonia, now in its infancy, is nitriding steel, a process equivalent to case-hardening, which also renders the steel rustless. In discussing methanol and other synthetic organic compounds related to ammonia, Mr. Crane stated that the Du Pont Ammonia Corporation has regularly been producing large quantities of higher alcohols by high-pressure synthesis from water gas along with its manufacture of methanol for the past year or two. A large plant for the production of higher alcohols now is nearing completion. The output of this plant is intended primarily for consumption as solvents in the manufacture of lacquers and thinners.

Expansion in the association's service to its membership was the keynote of the address by Lammot du Pont, president of E. I. du Pont de Nemours & Company and president of the association, who, with other officers of the association, was re-elected for the ensuing year. W. N. Watson, former chief chemist of the Tariff Commission, was elected secretary to succeed the late John I. Tierney, of Washington. Dr. E. B. Brossard, chairman of the Tariff Commission, was the principal speaker at a banquet attended by members and guests of both the Manufacturing Chemists' Association and the Synthetic Organic Chemical Manufacturers' Association. Dr. Brossard described the functions of the Tariff Commission and explained various provisions of the pending tariff bill. Dr. E. H. Kilheffer, Newport Chemical Works, was the toastmaster.

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Electroplaters Will Meet

Four technical sessions have been arranged for the annual convention of the American Electroplaters' Society, which will be held at the Mayflower Hotel, Washington, July 1, 2, and 3. Visits also are planned to the Bureau of Standards, Bureau of Engraving and Printing, and the Naval Gun Factory.

Coal Research Laboratory At Carnegie Institute

GIFTS totalling $425,000 to extend over a five-year period for the establishment and maintenance of a coal-research laboratory at the Carnegie Institute of Technology were announced last month by Dr. Thomas S. Baker, president of the institution. The Buhl Foundation of Pittsburgh is the largest single donor to the project, contributing $50,000 at the outset for equipment, and $25,000 a year for five years for a program of pure research. The firms co-operating are the United States Steel Corporation, the General Electric Company, the Koppers Company, the New York Edison Company, the Standard Oil Company of New Jersey, and the Westinghouse Electric & Manufacturing Company. These six corporations will contribute a total of $50,000 a year for five years.

The laboratory will be located on the north side of Engineering Hall of the Carnegie Institute of Technology in a new wing constructed last summer. The plan for the new laboratory will go into effect July 1, 1930. Several prominent scientists are being considered as members of the staff, and it is expected that a director for the laboratory will be announced soon. The laboratory will be a part of the Carnegie Institute of Technology, and will undertake fundamental research in coal and the products which may be obtained from it. The Carnegie Institute of Technology will organize graduate courses for the training of students in fuel technology in connection with the research laboratory, with the research staff giving instruction.

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Royal Dutch Co. Will Use Hydrogenation Patents

HYDROGENATION patents held by the Standard Oil Company of New Jersey and the I. G. Farbenindustrie of Germany, for the production of refined oils from petroleum will be worked by the Royal Dutch Company, according to a statement made by that company.

The statement says that reference has been made in previous reports to inventions of processes for the manufacture of synthetic benzine either from coal or from oil to which the company has given the greatest attention. It has now been decided to pool interests with those of the Standard-I. G. combine in order to exchange experience and patents in this direction and to work the hydrogenation patents jointly.

By combining with other interested parties, some of which are large chemical industries, all further inventions and improvements will be concentrated in one central body and thus this process, by which high-grade products can be made from greatly varying raw materials, can be applied on the widest possible scale.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

DURING THE past month the tariff has gone far through its predestined maze of legislative wanderings. At last the way to the White House is in sight, where, as all suppose, the President is waiting with poised pen to bid the errant bill arise as the Tariff Act of 1930. So far as the rate structure is concerned, little of importance generally and nothing in the chemical line has happened for the past two months. The chemical rates stand as tabulated in the April issue of *Chem. & Met.*

Since the last account, the bill was removed from deadlock by releasing the Senate conferees to make a compromise with the House. Before this time, scarehead press notices were despairing the bill. So close was the decision that the Vice-President had to cast the deciding vote. Then the conferees got busy and patched up differences on controverted items, striking out the duty on silver, shingles, and softwood logs, poles, and ties. Softwood lumber went to $1 per 1,000 ft. board measure and all cement was made dutiable at 6c. per 100 lb. The debenture was eliminated and the flexible provision and Tariff Commission powers considerably strengthened. After reaching this point, the bill has been thrust in and out of conference by parliamentary points of order, first on the flexible provision and then on minor items separated with a fine-tooth comb, as cherries, cheese, rayon, and watches. The points were sustained and corrected, because the conferees had inadvertently gone beyond the language of both the House and Senate.

WITH these involved technical matters out of the way, early passage of the bill seems assured, despite the barrage of informed and uninformed criticism which is being directed against it. And this is being written, the pro-tariff forces are conceded a narrow but sufficient majority, though there is little doubt that the vote will be close. There is some thought that Senator Grundy's vote will be registered against the bill. In this case, tariff proponents could say they had evolved something too low to suit the high protectionists and too high to please the free traders; thus that the result must be about right. Senate action is expected before this issue goes to press, with early House adoption virtually certain.

Now that the new rates have been on paper long enough to permit detailed analysis, the effect of the 1930 tariff on chemicals is more obvious. Commenting on the chemical schedule, Senator Smoot, high pilot of the bill, traces most of the increases to six items: olive oil; soy bean oil; casein; starches, dextrines, glue, and gelatin; oleic and stearic acid; and butyl and amyl acetate. While all have been applied to benefit American farmers producing the raw materials, the effect on the four latter items is to have the processing done in this country, thus tending to aid the plants engaged in this work in so far as tariff is effective in so aiding.

In the chemical schedule, 469 out of 556 items remain unchanged. Of the balance, 47 have been increased and 66 decreased. These figures include 14 transfers from the free list to the dutiable list and 26 in the opposition direction. At a glance, this would seem to be a bad break for chemicals with such a preponderance of decreases, but most of these are accountable to fertilizer materials, on which free listing is acceptable to the industry, and to a number of small items either of no import importance or not produced in this country. Although the industry has not received many of the increases desired, its rate structure has been maintained with a number of small gains. It is further fortunate in not having to pay higher rates on raw materials, with a few exceptions, such as linseed and certain oils. Through the rest of the bill, fully three-fourths the upward shift in rate level has been due to agricultural raw materials and their compensatories. Had the industry been let in for sky-high duties on tropical oils and starches, as farm people asked, a heavy customs burden would have been thrown on soap manufacturers, textile starch makers, without much benefit to the domestic oil industry.

SINCE the House passed the Reece bill for private leasing of the Muscle Shoals properties last month, unsuccessful attempts have been made in conference to reach a compromise with the Norris government operation bill, which passed the Senate in April. As is usual with such sharply divergent measures from opposite wings of the Capitol, recession by either chamber has been slow in developing. Senator Norris is willing to let the chemical plants go into private hands so long as the power remains under public management. According to a plan proposed by the Senate conferees, this would be done with the proviso that the nitrate properties be required to manufacture exclusively fertilizers and fertilizer ingredients instead of simply satisfying a tonnage requirement and branching out into ferro-alloys and other lines, as the house bill permits. To compensate for not controlling the power plant, the lessees would be given all necessary current at a minimum rate. An offer of cheaper fertilizer to the agriculturist and the avoidance of "power trust" control of Muscle Shoals power are the avowed purposes.

FEW radical changes in the alcohol permit regulations are expected from the initial revision under the Williamson law. A tentative draft of the new regulations will be submitted to representatives of the alcohol-using trades for criticism early in September, but it is probable that changes incident to the transfer of prohibition enforcement from the Treasury to the Justice Department will be an evolutionary process dictated by experience under the new dual system.

Apprehensive lest the authority granted to the Attorney General to participate in framing regulations and to veto permit applications would hamper legitimate industry if arbitrarily exercised, the alcohol-using trades have been somewhat reassured by the disposition of G. A. Youngquist, Assistant Attorney General to leave industrial alcohol matters largely to the discretion of James M. Doran, whose title now is Commissioner of Industrial Alcohol. It is becoming evident that the Department of Justice will interest itself only in cases where fraud is suspected and will not subject legitimate industry to suspicious scrutiny.

Doubtless the Department of Justice has been influenced in its policy of non-interference by the recent decision of the Supreme Court of the United States nullifying the regulation requiring annual renewal of permits on the ground that it exceeds the scope of the Volstead Act. Under this regulation, the old Bureau of Prohibition could deprive a manufacturer of his permit without resort to formal revocation procedure simply by failing to act on his application for renewal. If called upon to explain later, the Bureau had simply to report, in cases where investigation exonerated the manufacturer of misdoing, that the delay in renewing the permit was caused by congestion of official business. The court's decision will remove a great hindrance to the efficient operation of legitimate industry in which alcohol is an essential raw material. Manufacturers no longer will be disturbed by delay in the renewal of their permits.

LITTLE change is expected in the procedure incident to applications for basic permits by the small number of new manufacturers entering the field and for amendments desired by existing permittees to enable them to handle new business not covered by their original permits. It is reported that a copy of the applications made to the local prohibition administrator will be referred by him to the local officer of the Justice Department prohibition enforcement staff, but that the administrator will be free to issue the permit if the legal officer does not act within five days. This departure from past practice would entail some delay, and is objectionable to the alcohol-using trades for that reason, but it is not expected that the Justice Department official will intervene except in cases involving an unusually large increase in the manufacturer's quota.

Consolidations Effected in British Companies

High Quality Insulators Now Made at Stourport

From Our London Correspondent

IN SPITE of the international depression and the outwardly deplorable conditions of business, signs are not wanting that both confidence and activity will revive in the near future, irrespective of the continuance or otherwise of the present government. Although the basic industries are very depressed, they also are being initiated in the painful business of rehabilitation and rationalization, on which latter subject the *Times* recently published a most informative and authoritative series of articles.

The Securities' Management Trust and the Bankers' Industrial Development Company, referred to last month, have already taken the first steps in the iron, coal, and steel industries, in supporting the grouping of the Pearson & Knowles, Wigan Coal & Iron and Partington Steel companies, involving a present capital of some $30,000,000 and the provision of about $10,000,000 of fresh capital through the Bank of England and Messrs. Schroder. The Partington Company being on the Manchester Ship Canal, important developments may be expected in that district also, the proximity of chemical works offering interesting possibilities. Similar regrouping in South Wales and elsewhere shows that enterprise is not dead and that state-compelled amalgamations, such as have been proposed in the coal industry, are of doubtful value. In considering trade and unemployment figures, the usual British habit of viewing the black spots instead of drawing attention to the brighter side is fairly obvious, inasmuch as the more modern industries are all showing considerable expansion and gradually absorbing labor previously fitted for basic industries.

A NEW industry in this country of far-reaching importance has been created at Stourport, Worcestershire, for the manufacture of high-quality insulators. Steatite & Porcelain Insulators, Ltd., was formed last year under the auspices of Falk Stadelmann & Company and Imperial Chemical Industries and to transfer, incidentally, the business of the Clay Ring Company, which had previously had experience with Steatite in connection with the manufacture of rings for gas mantles. The managing director, C. S. Garland, who is well known also in America, was one of the pioneers in the latter industry and his driving power and technical and business capacity were of outstanding value in planning the factory on the most modern and efficient lines. Particular care has been taken in the control of all raw materials and in extreme accuracy in manufacture. In addition, the possibilities of steatite in specialized directions are of considerable importance, apart from having available for the first time in this country high-tension insulators suitable for power development on the largest and most modern scale. The high-tension testing laboratory enables insulators to be tested up to 1,000,000 volts and the research laboratories include also vibration and porosity testing appliances.

ONE of the most interesting papers to be read at the forthcoming World Power Conference in Berlin is that contributed by Colonel G. P. Pollitt, of Imperial Chemical Industries, and entitled "The Synthetic Ammonia Industry." There is, of course, a valid excuse for introducing this subject, inasmuch as the synthetic ammonia industry, particularly when based on electrolytic hydrogen, is a very large consumer of electric energy. Beyond that, the paper gives one the impression of an endeavor to draw far-reaching conclusions upon admittedly incomplete information and with a very natural bias, due to intimate association with one of the largest nitrogen enterprises in the world. Very interesting figures in regard to world nitrogen production and consumption of energy are given, but in regard to the latter the comparison has been made to look rather more in favor of water-gas hydrogen owing to the inclusion in each case of some 2,000 kw.-hr. per metric ton of nitrogen, this being the amount required for its fixation as ammonium sulphate and using the gypsum or anhydrite process. It is significant that several pages are devoted to a comparison between the relative merits of coke-oven gas and water gas as a source of hydrogen, and Colonel Pollitt is at pains to show the superiority of the former, although he is bound to admit that the two processes may still be expected to develop side by side.

In drawing his comparison, a good deal of legitimate criticism could be levelled against the assumptions and figures upon which they are based, and in particular the fact that Colonel Pollitt bases them upon a plant of 500 tons per day of ammonia for the water-gas process and only 50 tons for coke-oven gas. It seems most unlikely that any new enterprise will contemplate building a water-gas plant on such a scale, and conversely a somewhat higher figure would be an economical unit for coke-oven gas.

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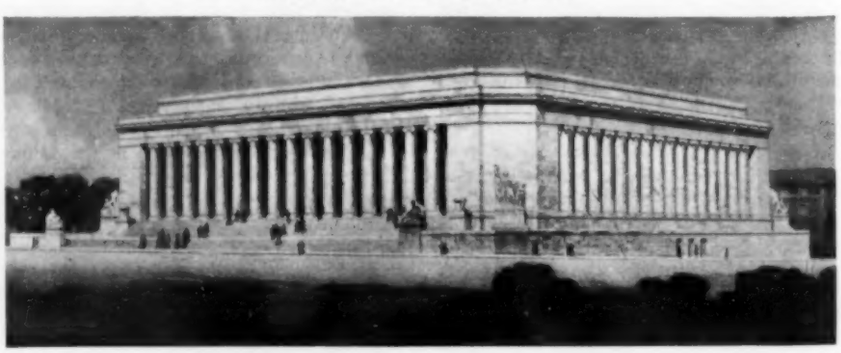
Mellon Institute Will Erect New Building

ANNOUNCEMENT has been made by Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa., that the institution is to increase its facilities for serving American industries by a building project that will enable the material expansion of all its research activities. Detailed plans are now being prepared by the architects, and construction will begin as soon as the drawings are completed, early this fall.

The present department of research in pure chemistry will be expanded and facilities for pure research in other branches of science will be provided. Much more elaborate chemical engineering laboratories are to be available in the new building, and also the fellowships in each specific field of industrial research are to be grouped in suites of rooms so that they can best make use of general apparatus adapted to their needs. Certain rooms will be equipped for specialized phases of experimental technique, such as electrochemistry, spectroscopy, low-temperature studies, radiations, high-pressure experimentation, and the like. Other special features to be included are a large lecture hall, a dining hall, an industrial fellowship museum, and an underground garage. For the past five years members of the institute's executive staff have been visiting important laboratories in America and Europe to obtain information on new features in design and equipment.

Future Home of Mellon Institute



Chemical Companies in France Prospered in 1929

Financial Statements Generally Showed Profitable Operations

From Our Paris Correspondent

ACCORDING to financial statements, the large chemical firms of France did well in 1929. We had mentioned this in a previous letter and the following figures clearly indorse our statement. The Saint-Gobain Company, for instance, shows a net profit of 65½ million francs, against 58½ million francs in 1928. The firm's capital was recently raised to 310 million French francs (formerly 225 million French francs), and the last-named capital will shortly be doubled. The aforesaid firm is keenly interested by the Berre Refineries (Raffineries de Berre), a new company recently created for the refining of petroleum and the manufacturing of its byproducts. This firm's capital was at first 110 million French francs; but it is now 200 million French francs.

Another instance of prosperity is shown by the Alais Froges Camargue Company's profits in 1929: 65 million French francs, against 58 million in 1928. The firm's capital has also increased from 208 to 268 million French francs. The Alais Froges Camargue Company is France's biggest alumina producer. On the other hand, though the Kuhlmann Company has increased its capital to 312½ million French francs the shareholders' dividend still remains at 40 fr., as in 1928, thus increasing the firm's profits notably to 48½ million French francs. The Bozel-Maletra Company, with a working capital of 88 million, realized a net profit of 15¼ million for last year, and the Matières Colorantes de Saint-Denis with a working capital of 50 million French francs, saw its yearly profits increase to almost 11 million.

Generally speaking, all dividends distributed have been increased and when one knows how careful and cautious French trustees are, one can easily realize that large sums are paid out into sinking funds and that the general situation is good financially. Unfortunately, business remains slack and if, strictly speaking, there is no real crisis, as there is no unemployment, business is far from active. On the other hand, sales prices have not changed, while taxation continues to increase and the new social insurance law coming into force on July 1 will add to costs, leaving but a very narrow margin of profit.

THE French glue and gelatine trade is known by the superior quality of its products more than by the importance of its output. As a matter of fact, there is no essential difference between glue and gelatines, the latter being merely made of finer raw matter and manufactured in thin plates from 0.1 to 0.3 millimeter thick. All glue factories naturally are built in the neighborhood of big cities, where raw matter can easily be found. The latter is of various kinds, some factories using bones, others waste leather, and the like. The bone-glue factories not only collect bones from France but in all the neighboring Mediterranean countries, also Argentina and India. India alone supplies yearly almost 15,000 tons of bones to gelatine manufacturers.

French gelatine works manufacture nearly 7,000 tons of glue, imports reaching 1,000 tons while exports reach 3,000 tons, the home consumption, therefore, being about 5,000 tons. The byproducts of glue are bone powder used as fertilizers (about 30,000 tons yearly), also tallow used in the soap and stearine industries. Hide glues, which utilize clipping of hides, waste leather, etc., are made also in the close vicinity of great tanning centers such as Paris, Lyons, Givet, Angoulème, and Roubaix. About 35,000 to 45,000 tons of tanning waste is thus used, yielding a total output of 4,000 to 4,500 tons of glue, of which 2,000 to 3,000 tons is exported, despite the heavy customs duties of the countries of importation. Among the main consumers of French glues are Great Britain, the United States, and South America, the U. S. customs duties being the heaviest.

WE HAVE already referred to a new firm, the Ketol Company (Sté. Le Ketol), which manufactures various products derived from butyric acid. This firm has a working capital of 25 million francs. The process used to obtain butyric acid is to saccharify sawdust according to the French patent 541,535 (Sept. 26, 1921), and the sugar thus obtained is fermented in order to produce butyric acid, as well as propionic and valerianic acids. This product is then neutralized with quicklime, and the calcium salts mixture obtained yields by distillation a mixture of Ketones which can be fractionated according to the uses contemplated. Considerable difficulties have arisen in the manufacture of butyric acid, saccharified sawdust yielding poor results, as expected. Other raw matters have therefore to be used; either manioc or mollasses. The latter is especially used in the Cattenoix Works, which produces 2 tons of ketol daily. Ketol is used as a solvent in cellulosic varnishes; also as mixer in the mixed alcohol and petrol carburant, as it prevents the separating of water.

Unfortunately, the high price of raw materials in the manufacture of ketol has made cost prices so high that, in order to be able to compete favorably with other solvents on the market the manufacturers of ketol are compelled to make sacrifices. The result is that the company has already lost about half of its working capital (December, 1929). Nevertheless, at a general meeting it was decided to carry on the manufacture, making full use of remaining capital.

The potash mines' output increases constantly; in 1929 the total output reached 3,132,000 tons of raw salts, against 2,580,000 tons in 1928. Two firms are responsible for this: the Domanial Mines, with 2,215,000 tons, and the Kali Sainte Therese Company, with 918,000 tons. The former mines are a combination of ten former German companies sequestered at the armistice and at present worked by the French State, though not owned by it. No definite decision regarding these mines has been accepted and voted by Parliament, though several plans have been discussed and rejected. This temporary state of affairs is prejudicial to the Domanial Mines, as the following recent incident clearly shows. Potash exports shipping through Antwerp reached 615,000 tons in 1928, far too large a quantity for the harbor, which has facilities for stocking only 120,000 tons. The Domanial Mines therefore approached the Rotterdam harbor authorities to export through Rotterdam. The Belgian government immediately protested, and all arrangements made with the Dutch harbor had to be cancelled. This clearly demonstrates, however, the drawback of state-managed concerns such as the Domanial Mines, for had these mines been a private French concern the result of the official Belgian protest might have been different.

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Canadian Chemists Urge Use of Waste Gas

PROMPT action by the Dominion Government on the report of a committee appointed to look into the waste of natural gas in the Alberta oil fields, was recommended by the Chemical Engineering Section at the Thirteenth Annual Canadian Chemical Convention held in Ottawa on May 28. The recommendation followed presentation of a paper by B. F. Haanel, Chief of the Division of Fuels, Department of Mines.

Speaking of natural-gas wastage in the Turner Valley, Mr. Haanel said the quantity of gas now lost amounted to 300,000,000 cu.ft. per day. He suggested this waste gas could be used for the production of electrical energy on a large scale. Such a quantity of waste gas, he said, could generate, through steam generators and turbines, 860,000 hp. per 24 hours.

Dr. Edgar Standfield, of the Alberta Research Council, stated he had been informed that as soon as Alberta took over the control of its natural resources, a bill which had been prepared for the regulation of the Turner Valley, would be passed by the Legislature.

Hydrogenation of Coal Makes Progress in Germany

Fuel Supplies Are of Wide Economic and Technical Interest

From Our Berlin Correspondent

FUELS of all sorts continue foremost in economic and technical interest in Germany. Distant supply of gas, for example, by the Ruhrgas A.G., is developing from month to month. Deliveries in 1928 amounted to about 400,000,000 cu.m., and in December, 1929, alone the figure was 47,000,000, and in January, 1930, 64,000,000. Germany has become a factor likewise in the petroleum industry, due to two circumstances. The first is the experimental exploitation of oil fields in the Northwestern region; the other is her share in the hydrogenation patents under which the Standard Oil Company of New Jersey is fostering a commercial project of universal significance.

The difficulties that have beset the hydrogenation of coal commercially are gradually being investigated and overcome. A new patent of the Bergin A.G. utilizes the already known principle of pressure-hydrogenation of coal or hydrocarbons. The hydrogenation and cracking follow in two different consecutive steps, the temperature in the second step being the higher, in order to yield valuable liquid distillation products. If coal, for example, with hydrogen at a pressure of 100 atmospheres, is heated directly to 400 deg. C. and maintained there for an hour, coking takes place; the coke clings to the walls of the apparatus, and the progress of the process is greatly hindered. However, if heating is carried out first for a half hour at 390 deg. C. and subsequently an hour at 450 deg., coke formation is avoided and a valuable liquid product obtained (about 60 per cent yield), comprising about one-third each of gasoline, Diesel oil, and fuel oil.

BENZOL refining with chlorine is proposed by T. I. Rabek. Chlorine has practically no effect on benzol in the absence of a catalyst and the assumption that the unsaturated compounds are first chlorinated while benzol is not attacked until they are used up, has been confirmed by experiments. Present automotive standards for benzol require a product of purity equal to that employed in chemical industries. It was found that the unsaturated compounds occur mainly in the highest and lowest fractions of crude benzol, hence the latter can be roughly purified by fractionation. Using chlorine, then, the unsaturated compounds are attacked first, then the sulphur compounds are chlorinated, and the benzol itself is unchanged. Thiophene and its homologues are completely removed.

The excessive increase in production of nitrogen fertilizers has caused the Gelsenkirchener Bergwerks A.G. to curtail its fixation projects, as a direct effect of the recently completed negotiations between the Ruhr producers and the I.G. Farbenindustrie. Present market developments make a complete exploitation of even the existing installations problematic.

With ethylene chloride in mind as a raw material for glycol, H. Bahr and H. Zieler have studied the action of chlorine on ethylene. The chloride forms without catalysts only at low temperatures, a yield of 90 per cent resulting at —20 to —30 deg. C. Still lower temperatures have no effect, but at higher temperatures the yield becomes poorer. At room conditions and above, trichlorethane is the main product, suggesting a large-scale process. Byproducts are ethylene chloride and more highly chlorinated products. Variation of the quantity ratios does not guide the course of the reaction, which depends only on the temperature; furthermore, the reaction is not a succession of steps toward higher chlorination, but an immediate result of the contact of ethylene and chlorine.

Two new developments in chemical fire extinguishers are the Erkalen, made by the I. G., which, by wetting such materials as lignite, permits the action of water; and another comprising a CO_2 holder emitting a thin stream of saturated alkali carbonate solution, which is useful in the case of oil and gas fires, with the added advantage of an increased extinguishing power the hotter the flames become.

A NEW process for the metallization of wood has been worked out by Dr. Schmidt, of Düsseldorf. It is distinguished from other similar processes in that it is not a coating but an impregnation of the wood with lead, tin, or other alloys and metals. This yields an entirely new material of construction which, like iron in reinforced concrete, has entirely new properties for various purposes. The process, which is relatively simple, consists of immersing the dried wood in the molten metal and then subjecting the whole in the closed vessel to a mild pressure. The greatly increased hardness of the wood as well as its capability of absorbing oil to a considerable degree makes it very suitable for bearings and special applications where expensive, exotic woods have been used in the past. A case of this is in iron mills as well as in bearings which may not be oiled.

Natural basalt can be transformed into a very suitable chemical material of construction by fusion. Suitable heat treatment—that is, proper cooling—produces a material of dense, fine crystalline structure, possessing good chemical as well as mechanical resistance.

This spring an aluminum material named "Cupal" has been brought on the market, which consists of that metal plated in different degrees with copper. Welding of the two metals to an inseparable unit offers new properties and fields of application not possessed by either alone. Similarly the aluminum plated with tin, called "Zinnal," combines many advantages of these metals. The firm of Hetzel & Company in Nurnberg is responsible for these developments.

The marketing of fertilizers, cement, and other pulverized material has been facilitated by the use of bags lined with pasted paper, which combines the advantages of dustless shipment with a reduction in weight and greater exploitation of the available shipping space. These sacks are cheaper than especially densely woven sacks; which are never completely dust free anyway.

Professor Willstätter recently expressed a demand for chemists in Germany industry: contrary to discouraging the student from chemistry he believed that the present difficult situation should invite suitable students to it.

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Textile Foundation Bill Signed by President

MUCH ceremony attended the signature by President Hoover, on June 3, of the Merritt bill creating the Textile Foundation for the purpose of administering in textile research the major portion of the $1,800,000 fund derived by the Textile Alliance from the sale of reparation dye. The President signed the bill in the presence of a group of distinguished government officials and men prominent in the textile industry who have actively sponsored the measure.

Secretary of Commerce Lamont and Secretary of Agriculture Hyde will serve as directors of the new federal corporation with three other persons familiar with the textile industry who are soon to be appointed by Mr. Hoover.

The initial resources of the Textile Foundation, amounting approximately to $1,200,000, will be increased by $200,000 within a few years. This latter sum will be held by the Alliance as a reserve pending final settlement of its affairs.

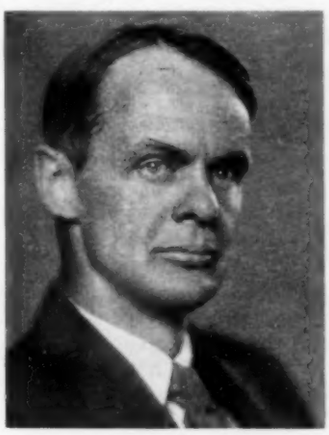
The sum of $400,000, representing 25 per cent of the total profits from the sale of the reparation dyes, will be distributed by the Alliance among the Philadelphia Textile School, Princeton University, and the Massachusetts Institute of Technology.

Under its charter the Textile Foundation is authorized to accept gifts and bequests from private organizations and individuals, and its sponsors hope that the resources of the foundation will be enlarged by such contributions.

MEN
IN CHEMICAL ENGINEERING

NORMAN W. KRASE, of the chemical engineering staff at the University of Illinois, will spend the summer months as consulting editor on *Chem. & Met.* In his editorial work, he will specialize on high-temperature, high-pressure studies.

WARREN N. WATSON resigned as chief chemist of the U. S. Tariff Commission on June 4 to become secretary of the Manufacturing Chemists' Association of the United States. Dexter North, Mr. Watson's assistant in the chemical division, was named acting



chief. Mr. Watson joined the staff of the Commission in 1919 following service during the World War as first lieutenant in the Chemical Warfare Service, and was appointed chief of the Chemical Division in 1926. Mr. Watson's most notable contribution to the chemical industry during his service with the Tariff Commission is the annual census of dyes and organic chemicals. He is a graduate of Bates College and holds a degree from Harvard University. During his industrial career Mr. Watson served as chief chemist for the Lewiston Bleachery & Dye Works, Lewiston, Me., and as chief chemist of the Arnold Print Works, North Adams, Mass.

FRANK M. SMITH, who has been vice-president of the Northwest Lead Company, Seattle, Wash., for the past ten years, was chosen as president of his company at its meeting in May.

D. D. JACKSON, head of the department of chemical engineering at Columbia University, is the new chairman of the American section of the Society of Chemical Industry.

HARRY F. LEWIS has left his position as head of the department of chemistry at Ohio Wesleyan University to become professor of organic chemistry at the newly organized Institute of Paper Chemistry at Appleton, Wis.

WILLIAM A. MANUEL, formerly of Western State College, Colorado, has been made head of the department of chemistry at Ohio Wesleyan University, Delaware, Ohio, succeeding Harry F. Lewis, who recently resigned.

ALAN H. RICHARDSON has left the department of chemistry at Columbia University to join Hayden Stone & Company, where he will be interested in chemical industry from the financial viewpoint.

E. A. DOYLE, consulting engineer of the Linde Air Products Company, has been elected president of the American Welding Society.

CHARLES M. A. STINE, chemical director of the duPont company, has been elected a member of the board of directors and of the executive committee.

WILLIAM RICHTER and HECTOR R. CARVETH were among the new directors elected to the board of the duPont company at its recent meeting.

FREDERICK G. KEYES, of the chemical department of Massachusetts Institute of Technology, and S. C. LIND, director of the school of chemistry, University of Minnesota, were elected members of the National Academy of Sciences at its recent 66th annual meeting.

A. H. KUNZ has accepted a position in the chemical department of the Du Pont Ammonia Corporation, Wilmington, Del. Dr. Kunz was National Research Fellow at the California Institute of Technology.

R. V. KLEINSCHMIDT, formerly research engineer with Arthur D. Little, Inc., has been employed by the Du Pont Ammonia Corporation as assistant manager of the technical department, Belle, W. Va.

ERVIN G. BAILEY, president of the Bailey & Meter Company and of the Fuller Lehigh Company, received the Edwards Longstreth medal of the Franklin Institute in recognition of his many inventions, especially along the line of controlling and measuring devices.

A. H. COOPER has joined the Krebs Pigment & Chemical Company, Newport, Del., to do chemical engineering research on the manufacture of lithopone.

EDWARD RAY WEIDLEIN, director of the Mellon Institute of Industrial Research, received the degree of L.L.D at the recent commencement of the University of Pittsburgh.

ROBERT J. MOORE, for the past six year general research chemist of Pratt & Lambert, Inc., Buffalo, has resigned to become development manager of the varnish resin department of Bakelite Corporation. In his new position, Mr.

Underwood & Underwood

Moore will work under L. V. Redman, vice-president in charge of research and development, at Bloomfield, N. J. He will be concerned with the application of newly developed resins in air-drying coatings. Mr. Moore formerly was on the teaching staff of Columbia University and later he became director of the Fraser Laboratories in New York City.

FLOYD B. HOBART has joined the Battelle Memorial Institute, of Columbus, Ohio, as fuel chemist under the direction of Clyde E. Williams, assistant director, who leads a group devoted to fuel research. Mr. Hobart is a graduate in chemical engineering of the University of Illinois, where he later taught gas and fuel analysis before joining the

CALENDAR OF FORTHCOMING EVENTS

AMERICAN ELECTROPLATERS' SOCIETY, annual convention, Washington, June 30-July 3.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 23-27.

INTERNATIONAL EXPOSITION AT LIÉGE, Belgium, chemical and engineering sessions, Sept. 14-21.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, New Orleans, December, 1930.

AMERICAN CHEMICAL SOCIETY, 80th meeting, Cincinnati, Sept. 8-12.

AMERICAN ELECTROCHEMICAL SOCIETY, fall meeting, Detroit, Sept. 25-27.

NATIONAL METAL CONGRESS, 12th annual meeting, Chicago, Sept. 22-26.

Engineering Experiment Station of the university in 1921. Here he worked with S. W. Parr as research assistant on coal, and left in 1927 to assume charge of the semi-plant experiment on the Parr process of carbonization for the Urbana Coke Company until 1929. Thereafter he was a chemical engineer with the Atlantic Refining Company.

EDWARD N. TRUMP has resigned from the Solvay Process Company, to resume his practice as consulting chemical and mechanical engineer at Syracuse, N. Y., on his return from the meeting of the World Power Conference in Berlin, to which he is a delegate.

L. W. ROWELL, president of the National Fertilizer Association, Washington, D. C., and manager of the fertilizer department of Swift & Company, Chicago, has been elected a vice-president of his company.

NIELS C. ORTVED, for 21 years technical manager and chemist for Hiram Walker & Sons, Ltd., of Walkerville, Ont., and president of the Detroit Motorbus Company, has had a bronze tablet prepared commemorating the discovery of electro-magnetism by his Danish countryman, Hans Christian Oersted. This plaque, which will be placed in the Museum of Science and Industry, Chicago, was on display at the meeting of the American Institute of Chemical Engineers this month.

CARL MARLING, formerly chief chemist of Lowe Brothers Company, Dayton, Ohio, is now with Thomas & Hochwalt, Inc., consultants, in that city.

THEODORE SWANN, president of the Swann Corporation, was recipient of the honorary degree of Doctor of Science from Oglethorpe University.

E. M. CLARK, president of the Standard Oil Development Company and the Standard Shipping Company, has been elected a vice-president of the Standard Oil Company of New Jersey. Mr. Clark began his 40 years' association with the oil industry in the employ of the Standard Oil Company of Indiana, and was later associated with W. N. Burton in the perfection of pressure stills.

FRANK VILBRANDT, formerly of the University of North Carolina, has become professor of chemical engineering at Iowa State College, Ames.

KARL JOHANN FREUDENBERG, of the University of Heidelberg, has been appointed Carl Schurz Memorial Professor at the University of Wisconsin for the coming year, where he will hold lectures and lead some research. His chief work has been along the line of cellulose, sugar, tannins, and stereochemistry.

H. L. GILCHRIST, chief of the Chemical Warfare Service, Washington, left that city on June 4 to make an extensive trip through the West, combining his first extensive inspection trip with business relating to the industrial mobilization plan of the Chemical Warfare Service.

DONALD I. GROSS, formerly research chemical engineer for the Industrial Fibre Company, of Cleveland, has joined the West Virginia Pulp & Paper Company, Covington, Va.

OBITUARY

JESSE W. BARNES, of the chemical staff of the Bureau of Chemistry and Soils, died after a very short illness at Washington, D. C., on June 1.

HENRY CLAY FOLGER, president of the Standard Oil Company of New York from 1911 to 1923 and its chairman of the board until 1928, died on June 11 in Brooklyn after an operation, at the age of 73. Mr. Folger, who had the finest collection of Shakespeareana in this country, spent his entire career in the oil business, from the time when he left school in 1879.

W. Y. FOSTER, JR., vice-president and general manager of the Hope Fertilizer Company, Hope, Ark., died on May 18 in that city, from a heart attack.

WILLIAM J. MATHESON, retired chemist and chemical executive, died suddenly aboard his yacht at Miami, Fla., on May 15, while returning from a cruise. Mr. Matheson, who was 73 years old, had made investigations on the application of coal-tar dyes in his earlier days and was later president of the National Aniline & Chemical Company; after his retirement from active business, he remained vice-president of the Corn Products Refining Company.

VIGGO B. DREWSEN, consultant in research for the West Virginia Pulp & Paper Company, died on May 18 at his home in Larchmont, N. Y., after a long illness. Born in Copenhagen 72 years ago, Dr. Drewson worked with Baeyer in Germany in the course of his education and came to the United States in 1895. His contributions have been chiefly in the field of pulp and paper technology, for which he received an honorary membership from the German Association of Pulp and Paper Chemists on his 70th birthday.

INDUSTRIAL NOTES

MODINE MANUFACTURING COMPANY, Racine, Wisconsin, has made the following appointments: R. M. Gunzel & Company, 1015 East 8th St., Los Angeles; R. F. Van Alstyne, 1034 Architects Building, Indianapolis, Ind.; J. I. Krugger, 357 9th Street, San Francisco, Calif.; E. W. Klein, 152 Nassau Street, Atlanta, Ga.; I. E. Burden, 227 Grand Avenue, Rockford, Ill.

H. E. CONKEY & COMPANY, Mendota, Ill., has changed the name of its manufacturing division to Conco Crane & Engineering Works.

OHIO STEEL FOUNDRIES COMPANY, Lima and Springfield, Ohio, has purchased the Industrial Brownhoist Corporation of Cleveland, Ohio, and Bay City, Mich.

MERCO NORDSTROM VALVE COMPANY has opened an office at 317 North 11th Street, St. Louis, under Leonard J. Kanard.

GRAVER TANK & MFG. CORPORATION has acquired Graver Corporation's steel construction and water treating business, with a plant at East Chicago, Ind.

MOUNT CHEMICAL EQUIPMENT COMPANY, Lynchburg, Va.,, will hereafter be the sole producer and seller of its special chemical equipment, which has heretofore been licensed to other firms.

TERRY STEAM TURBINE COMPANY, Hartford, Conn., has appointed S. O. Maxwell district manager at the New York office at 90 West Street.

TUBE-TURNS, INC., Louisville, Ky., has appointed the following new distributors: Grinnell Company, Charlotte, N. C.; Ebbert & Kirkman Company, Inc., Birmingham, Ala.; B. Huffmann Mfg. Company, Milwaukee, Wis.; United Pipe & Supply Company, Charleston, W. Va.; Vulcan Copper & Supply Company, Cincinnati, Ohio; Hedley & Voisinet, Buffalo, N. Y.

DURALOY COMPANY, Pittsburgh, Pa., has made H. T. Harrison district sales manager at Cleveland, Ohio.

HAZARD ADVERTISING CORPORATION, specialist in the chemical field, has removed to new offices at 295 Madison Avenue.

S. J. STOKES MACHINE COMPANY, Philadelphia, has added J. C. Coleman to its sales organization in the chemical process equipment division.

G. M. BASFORD COMPANY, advertising agency specializing in the process industries, has moved its offices to 17 East 42d Street, New York.

SWARTWOUT COMPANY, Cleveland, Ohio, has taken over the business of the S. C. Regulator Company, of Fostoria, Ohio.

CHICAGO BRIDGE & IRON WORKS has opened a new office in Houston, Texas, in charge of J. R. Donaldson.

BLAW-KNOX COMPANY, Pittsburgh, has now placed William E. Balliet in charge of its Birmingham office.

EDWARD VALVE & MFG. COMPANY, East Chicago, Ind., is now represented at Charleston, W. Va., by Riffe & Thomas, Inc.

ANDREWS-FREY SALES COMPANY has been organized at 620 Lewis Tower, Philadelphia, to handle steel equipment, especially for high-pressure gases.

FOOTE BROTHERS GEAR & MACHINE COMPANY, Chicago, has made Francis Emmons vice-president in charge of sales and advertising.

SHELL OIL COMPANY has moved its headquarters to the Shell Building, San Francisco, Calif.

SUPERHEATER COMPANY has moved its New York office to 60 East 42d Street.

STEPHENS-ADAMSON MANUFACTURING COMPANY, Aurora, Ill., has moved its New York sales and engineering office to 50 Church Street.

PRESSED STEEL TANK COMPANY has opened a Los Angeles office at 727 West Seventh Street, under J. A. Barr.

SWANN CHEMICAL COMPANY has been formed as a division of the Swann Corporation to consolidate Federal Phosphorus Company, Federal Carbide Company, Federal Fertilizer Company, Jax Plant Food Company, Southern Manganese Corporation, Southern Manganese Mining Corporation, and Southern Manganese Land Company. Its New York office is at 420 Lexington Avenue.

EDGE MOOR IRON COMPANY, at Edge Moor, Del., has appointed Harry L. Moody general sales manager at the main office.

AIR REDUCTION COMPANY, INC., has moved its executive offices to 342 Madison Avenue, New York.

H. K. FERGUSON COMPANY, Cleveland, has acquired the business of Warren D. Spengler, Inc., consulting engineers of the same city.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

STOCKHOLDERS of the Pruett-Schaffer Chemical Company and Hachmeister-Lind Company have approved the plan of merger of the two companies under the name of Hachmeister-Lind Company. Previously stockholders of Hachmeister-Lind Company approved an increase in capitalization of that company to permit consummation of the plan.

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Negotiations have been completed by the Procter & Gamble Company for the acquisition of James S. Kirk & Company. The purchase price was rumored to be close to $10,000,000.

•

E. I. duPont de Nemours & Company has applied to the New York Stock Exchange to list approximately $46,000,000 of additional common stock and $1,738,700 of 6 per cent non-voting debenture stock of no-par value. The additional common is in connection with the recent offering to common stockholders of rights to subscribe for 357,071 additional shares.

•

The Carbonic Products Corporation has amended its charter to increase its maximum capital stock from $5,000,000 to $7,350,000.

•

The American Commercial Alcohol Corporation voted June 6 to omit both cash and stock dividends on the common stock. The annual rate has been $1.60 a share in cash and 5 per cent in stock. Unfavorable conditions in the alcohol industry since the first of the year are given by the directors as the reason for omitting the dividends.

•

Plan for reorganization of the Associated Dyeing & Printing Corporation has been declared operative by the committee in charge. It also announces that legal proceedings will be instituted to effect the reorganization as speedily as possible.

•

Tubize-Chatillon Corporation has omitted the quarterly dividends due at this time on the $7 Series A preferred stock and on the Class B common stock. The regular quarterly dividend of $1.75 a share was declared on the Series B preferred stock, payable July 1 to stockholders of record June 20.

•

The American Cyanamid Company has entered into a contract with the Jefferson Lake Oil Company to explore the latter company's sulphur deposits under Lake Peigneur, in Iberia Parish, Louisiana. In the event that sulphur is uncovered in commercial quantities, the two companies will share jointly in the proceeds.

•

Columbian Carbon Company and subsidiaries report for quarter ended March 31, 1930, net income of $810,005 after depreciation, depletion, and federal taxes, equivalent to $1.62 a share on 498,505 shares of no-par stock. This compares with $1,059,957, or $2.32 a share on 457,344 shares, in first quarter of 1929.

•

United Chemicals, Inc., reports for quarter ended March 31, 1930, net profit of $142,752 after depreciation, federal taxes, etc., equivalent under the participating provisions of the shares, to 87c. a share on 115,150 no-par shares of $3 cumulative participating preferred stock and 41c. a share on 102,000 no-par shares of common stock outstanding at end of the period.

Price Range 1930 High	Price Range 1930 Low	Stock	Price Range in May May 1	Price Range in May High	Price Range in May Low	Price Range in May May 28
34	19	Agfa Ansco Corp	29	29	26¼	....
153	118	Air Reduction	142	153	130½	152½
2½	1¼	Ajax Rubber	2	2	1½	1½
343	255½	Allied Chemical	320½	328	295½	315
356	275	Aluminum Co	....	315	285	303
10¼	5½	Am. Ag. Chemical	7½	8½	5½	7
33	16½	Am. Commercial Alcohol	20	21½	16½	18
37	24¾	American Cyanamid, B	29½	30¼	24¼	26½
7	4½	American Hide & Leather	....	5	4½	4½
51½	39½	American Metals	41½	45½	39½	41
22½	10	Am. Solvents & Chemical	15½	16½	11½	12
43¾	15¾	Anglo-Chile Nitrate	34½	41½	31½	40½
29½	22½	Archer-Daniels-Midland	23¾	24¾	22½	24¼
8¼	5½	Armour, Ill., A	6½	7¼	5½	6½
51¾	36½	Atlantic Refining	43½	46½	38	43¾
106	78	Atlas Powder	91½	91½	78	80½
70½	58	Beechnut Packing	....	64½	58	59½
29¾	28	California Petroleum	....	29¼	28	....
35	20	Celanese	....	23	20	21½
20	13½	Celluloid Corp	....	16½	15	15
15¾	8½	Certainteed	11	11¾	8½	9½
32½	21¾	Chickasha Cotton Oil	....	27	21¾	22
64¾	59	Colgate-Palmolive-Peet	63	64¾	59	62½
199	128½	Columbian Carbon	156	165	128½	162½
38	25½	Commercial Solvents	31¾	34½	25½	30½
111¾	87½	Corn Products	103	108¾	94	108½
43¾	28¾	Davison Chemical	35¾	39½	30½	35½
42¾	30¾	Devoe & Raynolds	41	41¾	33	38¾
100	71	Dow Chemical	....	98	92	96½
145½	112½	Du Pont	130½	135½	120	130½
121	114½	Du Pont, 6 pc. deb	119½	121	119½	120½
21	12	Duval Texas Sulphur	....	17	12	....
255½	175¾	Eastman Kodak	242½	255	220¾	240
33½	21¾	Firestone Tire	23¾	24½	21¾	23¾
5½	3	Fisk Rubber	3¾	4¾	3½	3¾
55½	38½	Freeport Texas	50½	50¾	41½	48½
71½	49½	General Asphalt	58½	61¾	52¾	59½
14¾	8	Gen. Industrial Alcohol	11½	14	9¾	....
38	23½	Glidden Co	29½	30	23½	24¾
47¾	37¾	Gold Dust	44½	47¾	4½	44¼
58½	36	Goodrich Co	40	45½	36	40½
85	78½	Hercules Powder	....	80	79	....
23	19	Heyden Chemical	....	19¾	19	19½
116½	52½	Houston Oil	104	110	75½	102
....	....	Imperial Chemical Ind	....	5¾	5¾	....
124	90	Industrial Rayon	....	106	101	102
8½	4½	Int. Ag. Chemical	6½	6½	5½	6½
44¾	30½	International Nickel	34½	37	30½	33½
18	12½	International Paper, C	15¾	15¾	13¾	14½
153	69	International Salt	98	153	89	148½
25	20½	Kellogg, Spencer & Sons	23	23	21½	21½
6½	3½	Kelly-Springfield	4¾	5	4½	4¾
11	6½	Lee Rubber & Tire	7½	8	6¾	7½
36	28	Lehn & Fink	31	32	28	29
31½	19¾	Libby-Owens	26½	26½	22½	23
81½	52¾	Liquid Carbonic	68	75¾	60½	74½
37¾	25	McKesson & Robbins	30½	30¾	25	27½
51¾	37½	Mathieson Alkali	45¾	47	40½	45¾
63½	48¾	Monsanto Chemical	58½	60	51	56½
39½	29	Nat'l Distillers Products	33½	36¾	30½	35¾
189½	137	National Lead	....	151	140½	149
91½	66¾	New Jersey Zinc	79	80	74½	75
85	51	Newport Co., A	....	70	70	....
74¾	66¾	Ohio Oil	74	74½	70¾	73
60¾	50½	Owens-Ill. Glass	54	56	50½	52
44¾	29½	Phillips Petroleum	42½	44¾	37½	38
....	....	Pittsburgh Plate Glass	....	54	51	....
57¾	50½	Pratt & Lambert	....	54½	50½	50½
77	52¾	Procter & Gamble	74¾	77	67½	77
27½	21½	Pure Oil	25	25¾	22½	22½
85	80	Sherwin-Williams	....	83	80½	....
34½	18	Silica Gel	24¾	26	21½	24¾
32	21¾	Sinclair Oil	28¾	30	24¾	27½
42	28¾	Skelly Oil	37	38¾	32	36
75	55½	Standard Oil, Cal	71¾	74¾	67¾	70½
84¾	58	Standard Oil, N. J	80½	84	71	80¾
40¾	31¾	Standard Oil, N. Y	38¾	40	34½	37
3	1½	Standard Plate Glass	1¾	2½	1½	1½
70	53	Sun Oil	66	67¾	60¾	....
10	8	Swan & Finch	....	8	8	....
34½	29¾	Swift & Co	....	31½	29¾	30½
17	13	Tennessee Copper & Chemical	14	15	13½	14½
60½	50¾	Texas Corporation	58	60½	55	58¾
67¾	54¾	Texas Gulf Sulphur	60¾	61	55	60¾
17½	10¾	Tidewater Assoc. Oil	16½	17¾	14	17½
106¾	76	Union Carbide	85	90¾	79½	86
50	41½	Union Oil, Cal	46½	47	43½	45½
84	44¾	United Carbon	73½	78½	54½	68¾
32¾	25	United Piece Dye	....	31¾	26	30¾
139¾	84½	U. S. Industrial Alcohol	87½	94½	85½	89½
15½	7¾	U. S. Leather	11¾	12½	10½	11½
35	21½	U. S. Rubber	28½	31¾	25½	31¾
97¾	85¾	Vacuum Oil	94¾	97½	85¾	94¾
143½	49¾	Vanadium Corp	126½	133¾	87	122
47¾	37½	Vick Chemical	46½	47¾	44½	47½
8¾	5½	Va. Ca. Chemical	6¾	7¾	5½	6
29¾	22½	Wesson Oil	25¾	28¾	24	28¾
59½	37	Westvaco Chlorine	49	51	41	45
7¾	3½	Wilson & Co	4¾	5¾	4¾	5

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Deliveries of Chemicals Attain Large Volume

Seasonal Influences Have Twofold Effect on Consuming Demand

ACCORDING to a report published in *The Business Week*, the tide of business activity recedes further as the season of summer slackness progresses. The publication places the index of trade and production at 90.5 per cent of normal. The chemical industry is influenced by the state of general industry, but so far this year production of chemicals has been relatively higher than that of industry as a whole.

Contract deliveries of chemicals are being made with fair regularity and the aggregate movement attains a large tonnage. Most branches of chemical manufacture have operated below the rate in effect in the first half of 1929. Possibly a part of this falling off will be recovered in the second half of the year. But in any event both production and consumption of chemicals have gone ahead at a rate which justifies the statement that a large tonnage was involved.

The position of some branches of the producing and consuming industries may be seen from the following figures:

Production

	April 1930	April 1929
Acetate of lime, 1,000 lb.	9,807	12,071
Methanol, crude, gal.	617,031	746,007
Methanol, refined, gal.	424,295	502,010
Byproduct coke, 1,000 tons	4,246	4,457
Alcohol, ethyl, 1,000 gal.	12,221	14,709
Alcohol, ethyl, withdrawn for denaturing, 1,000 gal.	10,585	12,003
Automobiles, cars, No.	442,630	621,910
taxis, No.	565	1,686
trucks, No.	67,459	84,346
Explosives, 1,000 lb.	30,967	36,077
Glass, plate, 1,000 sq.ft.	11,430	12,555
Petroleum refined, 1,000 bbl.	80,434	80,459
Rosin, wood, bbl.	43,919	36,150
Turpentine, wood, bbl.	8,303	6,917
Pine oil, gal.	253,049	212,720
Cottonseed oil		
Crude, 1,000 lb.	76,628	80,497
Refined, 1,000 lb.	107,970	101,603

Consumption

Silk, bales	53,704	39,125
Wool, 1,000 lb.	36,794	49,205
Cotton, bales	532,382	631,802
Fertilizer in South, tons	1,279,874	1,258,114
Cottonseed oil, bbl.	317,900	290,574

The figures show that wood-distillation chemicals have receded in importance and the comparison in the case of acetate of lime is less favorable if shipments are taken rather than production figures. The position of the paint and varnish industry may be understood from a report of the Department of Commerce which establishes sales of paint, varnish, and lacquer products at a value of $121,725,857 for the first four months of this year, in comparison with sales of $140,548,639 for the corresponding period of 1929.

SEASONAL influences are given as reasons for a slowing up in some branches of the industry at present. The same reason is given for the greater interest shown in such products as copper sulphate, calcium arsenate, and citric and tartaric acids.

Export trade in chemicals and related products for the first four months of this year reached a valuation of $47,107,225, as compared with $51,352,488 for the corresponding period of 1929. Coal-tar products, because of larger shipments of benzol and coal-tar pitch, show up more favorably than was the case in 1929.

The value of industrial chemicals exported in the four-month period was $8,562,344, against $9,442,963 in 1929. Sodium compounds made a poor showing, with the outward movement totaling 196,521,000 lb., and 222,319,681 lb. for 1930 and 1929, respectively. Formaldehyde has sold more freely for export this year, and a marked gain is recorded in shipments of calcium chloride.

Import trade in chemical products for the first four months was valued at $51,502,636, against $54,391,705 a year ago. A marked decline is noted in arrivals of formic acid, but larger amounts of tartaric acid were imported. Copper sulphate and arsenic also entered in larger volume.

MANUFACTURING production in April, after adjustments for seasonal variations, showed a gain of 1 per cent over the preceding month, but was considerably below the same period a year ago, according to the weighted index of the Federal Reserve Board. The output of minerals registered an increase of 7 per cent over March, but was less than in April, 1929. Industrial production, including both manufacturing and minerals, also registered an increase over the preceding month, but showed a decline of 10 per cent when compared with a year ago.

The general index of commodity stocks held at the end of April, while below the level of those held at the end of March, was 5 per cent greater than a year ago, due mainly to the holdings of raw materials. The index of stocks of finished goods in the hands of manufacturers showed increases over March and April, 1929.

Unfilled orders for manufactured goods at the end of April showed a decline from both March and April, 1929. As compared with the preceding month, declines in most lines were general. Contrasted with April, 1929, unfilled orders for transportation equipment showed but slight change, while the other lines all registered decreases.

Total Production of Coal-Tar Crudes From All Sources in 1929

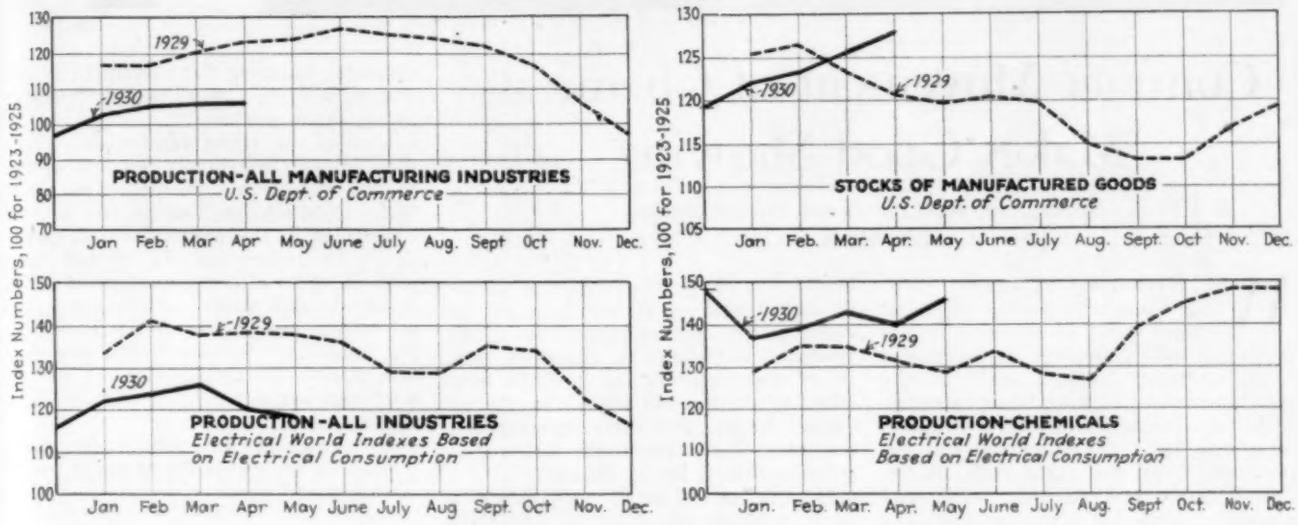
Product	Quantity	Value
Total coal tar, gal.	736,864,366	
Benzene (benzol), gal.	25,119,013	$5,310,107
Motor benzol, gal.	102,810,061	16,407,442
Carbolic oil or middle oil, gal.	214,574	27,060
Dead or creosote oil, gal.	167,685,263	19,317,457
Naphthalene, lb.	38,984,060	686,528
Other distillates, gal.	10,007,225	1,322,889
Pitch of tar, tons	646,538	
Solvent naphtha, including xylene, gal.	7,896,802	1,773,119
Refined tars, bbl.	2,440,748	11,537,899

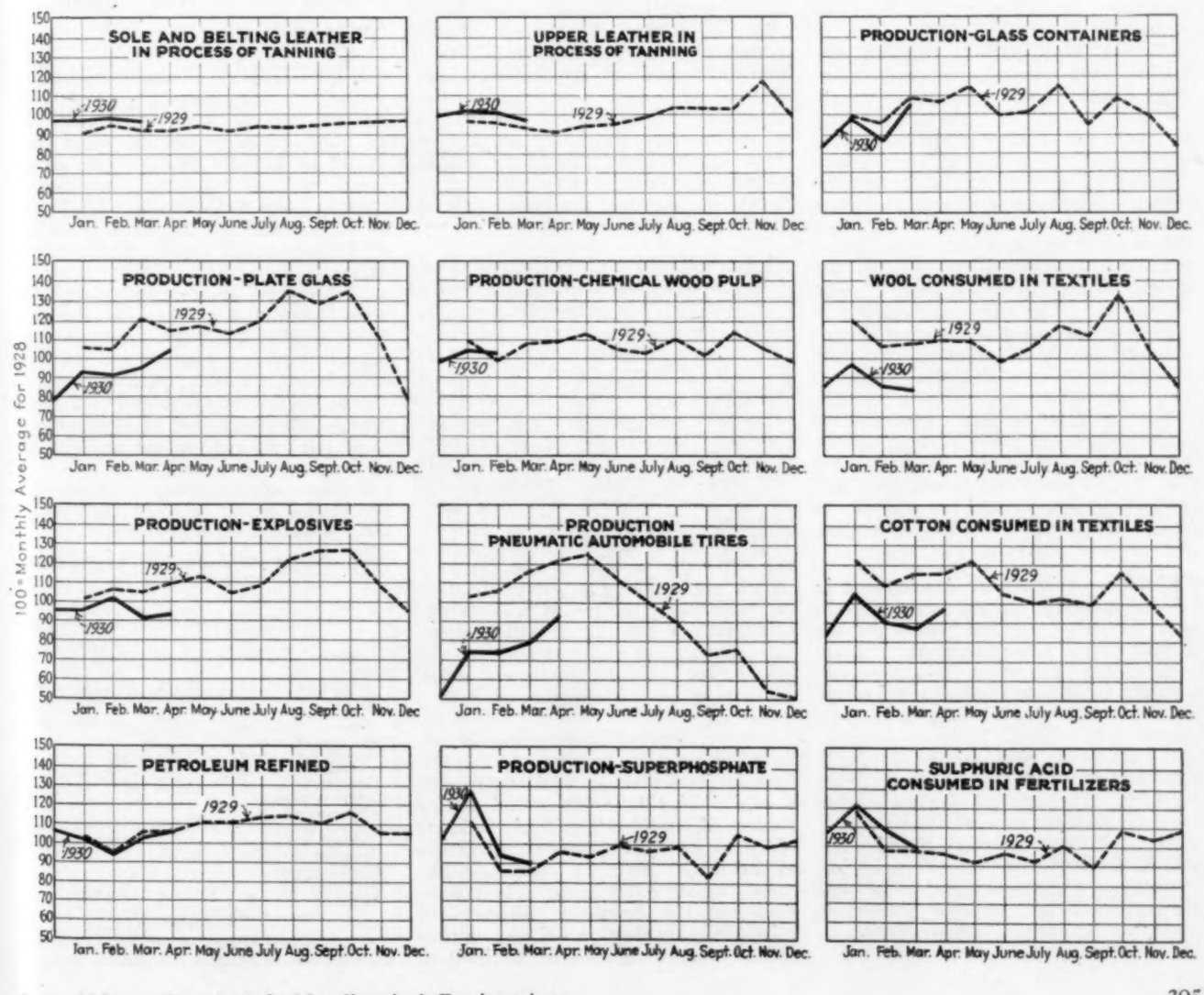
Coal-Tar Byproducts Obtained From Coke-Oven Operations in 1929*

	Production	Sales — Quantity	Sales — Value — Total	Sales — Value — Average
Tar, gal.	680,864,366	333,557,501	$16,982,406	0.051
Light oil and derivatives:				
Crude light oil, gal.	†200,594,027	11,090,709	1,374,527	.124
Benzol, crude and refined, gal.	28,832,002	24,558,745	5,169,743	.211
Motor benzol, gal.	105,923,762	100,807,852	16,063,285	.159
Toluol, crude and refined, gal.	18,343,295	17,064,206	6,580,176	.386
Solvent naptha (including xylol), gal.	7,131,111	6,581,047	1,591,333	.242
Other light oil products, gal.	6,684,568	1,886,362	126,183	.067
	‡166,914,738	161,988,921	$30,905,247	0.191
Naphthalene, crude and refined, lb.	19,595,548	19,442,381	319,037	.016
Creosote oil, gal.	26,730,126	23,938,431	2,296,862	.096
Phenol (crude), gal.	84,683	78,869	28,347	.359
Pitch of tar, net tons	88,158	5,599	27,273	4.871
Other products§	.....	.....	129,848	.....

*Includes products of tar distillation conducted by coke-oven operators under same corporate name, excepting, however, phenol and other tar acids produced at Clairton, Pa., which are covered elsewhere by report of the U. S. Tariff Commission. †Refined on the premises to make the derived products shown: 1929, 192,759,303 gal. of crude light oil. ‡Total gallons derived products. §Sodium prussiate, carbolate, sulphur, smoke compound, extile covering, and tar paint.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES


PRODUCTION-ALL MANUFACTURING INDUSTRIES
U.S. Dept. of Commerce
1929
1930
Index Numbers, 100 for 1923-1925
Jan Feb Mar Apr May June July Aug. Sept Oct Nov. Dec.
STOCKS OF MANUFACTURED GOODS
U.S. Dept. of Commerce
PRODUCTION-ALL INDUSTRIES
Electrical World Indexes Based on Electrical Consumption
PRODUCTION-CHEMICALS
Electrical World Indexes Based on Electrical Consumption



MARKET CONDITIONS AND PRICE TRENDS

Contract Movement of Chemicals Makes Good Showing

Specialties Receive More Attention in Spot Market

WITHDRAWALS against existing contracts during the last month were on a fairly steady basis and total deliveries were reported as satisfactory, although some consuming branches cut down their requirements as compared with their demands of a year ago. Good demand was experienced from the rayon, silk, oil refining, paint and varnish, soap, and glass industries. The cotton and wool branches of the textile industry were somewhat backward and tanners have not been active in market for raw materials.

In the spot market, seasonal specialties were attracting more attention, with a decided gain reported in volume of sales of copper sulphate, calcium arsenate, and similar products. Stocks of calcium arsenate held at Southern distributing points were materially reduced. Mexico also was said to have taken appreciable amounts of arsenate following a decree which authorized a lower import duty on this chemical entering Mexico up to the close of next November. The temporary decline in duty was made in order to give Mexico a larger supply of arsenate to combat the pests which threatened Mexican crops this season.

Copper sulphate was advanced in price following the recovery of the metal market from the 12c. level, but the rise in quotations placed no check on buying interest and, in addition to large contract deliveries, buying for new account was active.

THE most important development in the domestic market was connected with the passage by the Senate and the House, of the new Tariff Act. A review of the changes in rates, however, does not point to any widespread change in the position of specific chemicals. Acetic and tartaric acids of foreign make are placed at a greater disadvantage and the same is true for barium products. The removal of white arsenic from the free list may add to its selling price or it may encourage a wider domestic production which will make importations unnecessary. Casein undoubtedly will move to higher price levels under the stimulus of high protection.

Incidentally, greater prominence has been given to the importance of domestic acetic acid of synthetic origin because of the announcement that a new producer was about to enter the field. It is also regarded as probable that other producers will appear in the not distant future and that synthetic production will assume much larger proportions than it has in the past.

On the other hand, such items as urea, sulphate of ammonia, and Paris green should gain in our import trade as a result of the removal of duties.

The regulation announced on May 1 to the effect that after June 1 all ethyl acetate must be denatured by adding to every 100 gal. of ethyl acetate one-eighth gal. of a petroleum product known as "calol ethatate" was modified so as to make the order effective on June 15 instead of June 1. The additional time was granted because of delay in making available sufficient quantities of the denaturant.

A COMMUNICATION from Trade Commissioner Earle C. Taylor at Paris states that European press reports concerning the recently announced international cyanamid cartel credit the German producers with the idea of bringing together the world's producers of cyanamid in order to study the situation as it is affected by the growing world production of ammonium sulphate and new nitrogenous products, as well as the possible effect of a new international nitrogen cartel. A fact developed during the discussions was to the effect that at present the cyanamid plants are working at only about 50 per cent capacity, and it was decided that intensive propaganda will be necessary to increase consumption and that all of the cyanamid producers would participate in the expense of such a campaign.

Another foreign development of importance was the confirmation of previous reports that an organization with a capital of £75,000,000 would assume control of the nitrate of soda industry of Chile. The association will be known as Societdad Salitrera Nacional—National Nitrate Association. The present plans of the company call for the scientific organization of the nitrate industry, applying modern methods of economy, reducing the number of plants and simplifying the means of transportation of the product.

One of the terms of the plan gives the Chilean Government one-half of the stock in the new combine. The other half will be allocated among the various companies in the consolidated corporation. In return for its 50 per cent interest the Chilean Government, it is reported, will abolish all export taxes on nitrate and iodine and will deliver the remaining deposits to the company at a price to be agreed upon. Undeveloped deposits are said to contain 150,000,000 tons.

In the market for vegetable oils, much interest is shown in the growing crops of cotton and flax.

Production of Aluminum Salts in 1929

PRODUCTION of aluminum salts in the United States in 1929 was 394,093 short tons, valued at $11,677,728, as compared with 386,905 short tons, valued at $13,990,264, in 1928, an increase of 7,188 tons, or 2 per cent in quantity, but a decrease of $2,312,536, or 17 per cent in total value, according to a statement of the U. S. Bureau of Mines.

The makers of aluminum salts consumed 80,024 long tons of domestic bauxite and 62,320 long tons of imported bauxite, a total of 142,344 tons, valued at $1,912,576 at consuming works. There also were consumed 402 short tons of aluminum and 3,950 short tons of alumina hydrate in the manufacture of the salts.

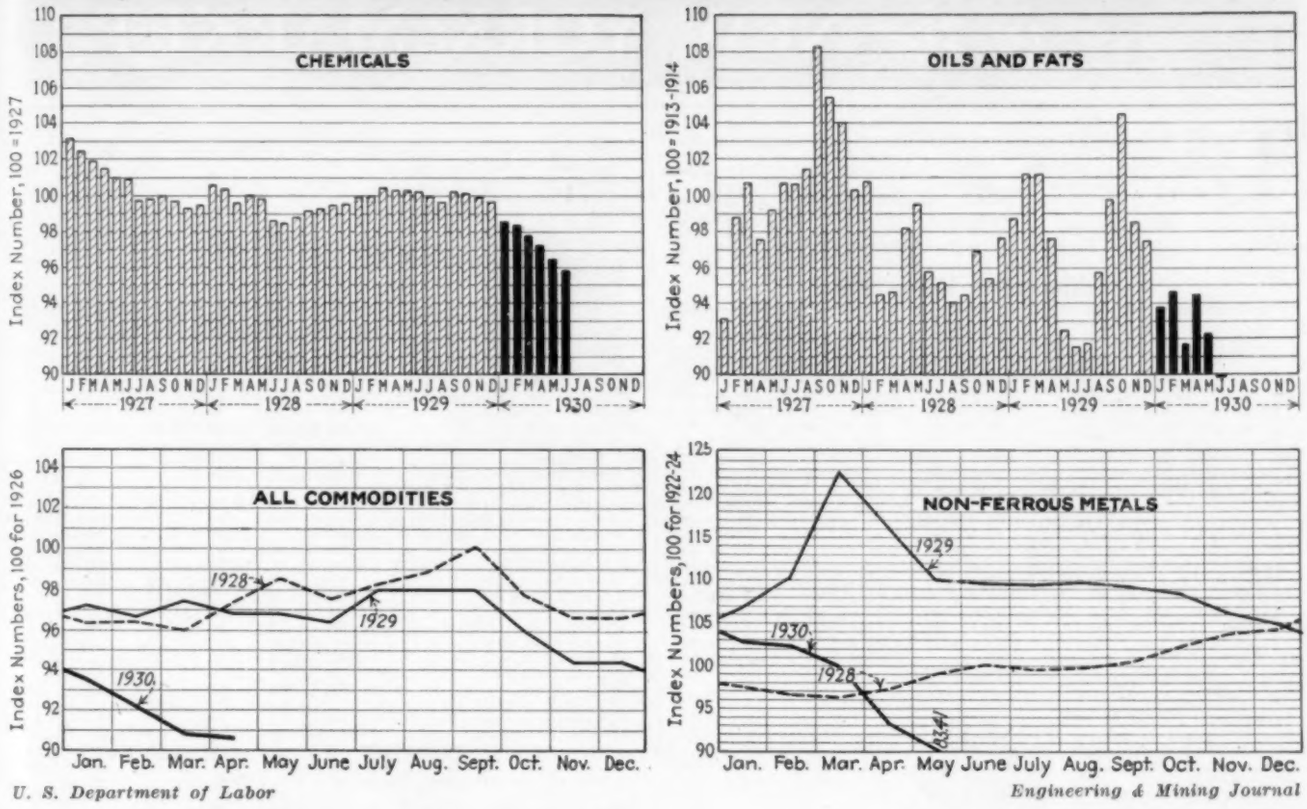
Exports of aluminum sulphate from the United States in 1929 were 26,588 short tons, valued at $607,757.

Production of Aluminum Salts in the United States in 1929

Salt	No. of Producers Reporting	Short Tons	Value—Total	Value—Average
Alum:				
Ammonia	5	5,108	$286,592	$56.11
Sodium	3	15,005	855,754	57.04
Potash	3	6,304	254,290	40.34
Other	1			
Aluminum chloride:				
Liquid	4	2,399	127,935	53.33
Crystal	3	365	43,148	118.21
Anhydrous	3	13,787	1,429,743	103.70
Aluminum sulphate:				
Commercial—General	11	319,736	7,589,244	23.74
Municipal	6	8,190	126,550	15.45
Iron-free	6	20,441	731,732	35.80
Other aluminum salts and hydrate	a5	2,758	232,740	.....
	..	394,093	11,677,728	.....

a Two producers each of alumina and sodium aluminate and one producer of aluminum stearate

CHEM. & MET. *Weighted Indexes of* PRICES


CHEMICALS
Index Number, 100 = 1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929
1930
OILS AND FATS
Index Number, 100 = 1913-1914
ALL COMMODITIES
Index Numbers, 100 for 1926
1928
1929
1930
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
NON-FERROUS METALS
Index Numbers, 100 for 1922-24
1929
1930
1928
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

U. S. Department of Labor — *Engineering & Mining Journal*

Easy Price Tone Rules in Market for Chemicals

WHILE fluctuations in prices for chemicals were not important during the last month, the undertone was easy and where price revisions were made they generally were in favor of buyers. Values appear to be influenced mainly by the volume of buying, and this has not been heavy enough to maintain equilibrium between supply and demand. So long as this condition exists any general firming up of quotations is not probable.

The tariff question, which is approaching settlement, provides for higher duties on specified chemicals. In cases where foreign-made chemicals compete with domestic offerings, advances in sales schedules are logical, with the rate of increase ultimately seeking a level commensurate with the rate of duty increase. Acetic, formic, and tartaric acids, arsenic, casein, and salt cake may be cited among the chemicals for which higher import duties are proposed. Arsenic and casein appear to be in a position where they will quickly respond to tariff revisions.

Chlorate of soda has been the object of competitive selling in recent weeks. The open quotation has been lowered, so that current sales have been going through at very low figures—too low to encourage the belief that they will continue for any protracted period.

Spirits of turpentine and gum rosin have found a disappointing export outlet and, as domestic buyers have not been active, values have continued to decline. Present sale prices are low and some consumers have taken on stocks, because they believe prices are on bottom, but further recessions may take place before any price improvement asserts itself.

Vegetable oils sold at concessions during the month. Toward the close, linseed oil became firmer, and with larger buying the market undoubtedly would go considerably higher. Domestic seed is well absorbed and Argentine seed has been delivered to Western crushing mills. The growing flax crop will be an important price factor in the next two months and prices for seed and oil may be expected according to the tenor of crop news.

China wood oil has been offered freely in primary markets and the low prices in effect have been accentuated by the position of exchange. Shipments from Hankow in May reached a total of 18,810,000 lb., of which 16,760,000 lb. was consigned to the United States. For the first five months of this year shipments from Hankow were 69,696,000 lb., of which 59,714,000 lb. was for this country.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**95.87**
Last month	96.54
June, 1929	100.25
June, 1928	98.67

An easy price tone pervaded the market during the month. Lower prices for salt cake, sulphate of ammonia, tartaric acid, chlorate of soda, tin salts, and some of the coal-tar chemicals were in effect. Naval stores also sold below the level of a month ago.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**89.23**
Last month	92.24
June, 1929	91.57
June, 1928	95.83

Practically all of the vegetable oils sold off during the month. Stocks are large in most cases and the easy tone was emphasized by lower values in primary markets for coconut, palm, and China wood oils. Animal fats also were weaker and contributed to the downward swing of the index number.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to June 13.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.11 - $0.12	$0.11 - $0.12	$0.14 - $0.15
Acid, acetic, 28%, bbl., cwt.	3.88 - 4.03	3.88 - 4.03	3.88 - 4.03
Boric, bbl, lb.	.06½ - .07	.06½ - .07	.06½ - .07
Citric, kegs, lb.	.46 - .47	.46 - .47	.46 - .47
Formic, bbl, lb.	.10½ - .11	.10½ - .11	.10½ - .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½ - .12	.11½ - .12	.11½ - .12
22%, tech., light, bbl., lb.	.05½ - .06	.05½ - .06	.05½ - .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10½	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 - 20.00	18.50 -	18.00 - 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .11½
Phosphoric, tech., c'bys., lb.	.08½ - .09	.08½ - .09	.08½ - .09
Sulphuric, 60°, tanks, ton	11.00 - 11.50	11.00 - 11.50	11.00 - 11.50
Tannic, tech., bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl., lb.	.36 - .38	.37½ - .39	.38 - .39
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl., gal.	2.63 -	2.63 - 2.71	2.68½ - 2.71
Alcohol, Butyl, tanks, lb.	.16½ - .17	.16½ - .17	.17½ - .18
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.236-	.236-	-
Denatured, 190 proof			
No. 1 special dr., gal.	.42 -	.43 -	.49 -
No. 5, 188 proof, dr., gal.	.42 -	.44 -	.49 -
Alum, ammonia, lump, bbl., lb.	.03½ - .04	.03½ - .04	.03½ - .04
Chrome, bbl., lb.	.05 - .05½	.05½ - .05½	.05½ - .06
Potash, lump, bbl., lb.	.03½ - .04	.03 - .03½	.02½ - .03½
Aluminum sulphate, com., bags, cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	2.00 - 2.10
Aqua ammonia, 26°, drums, lb.	.03 - .04	.03 - .04	.03 - .04
Ammonia, anhydrous, cyl., lb.	.15 -	.15 -	.14 -
Ammonium carbonate, powd. tech., casks, lb.	.10½ - .11	.12½ - .13	.12 - .13
Sulphate, wks., cwt.	2.00 - 1.10	2.10 -	2.30 -
Amylacetate tech., tanks, lb., gal.	2.22 -	2.22 -	-
Antimony Oxide, bbl., lb.	.09 - .10	.09 - .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs., lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	58.00 - 60.00	58.00 - 60.00	57.50 - 60.00
Chloride, bbl., ton	63.00 - 65.00	65.00 - 67.00	64.00 - 70.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.08 - .08½
Blanc fixe, dry, bbl., lb.	.03½ - .04	.03½ - .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.033 - .033	.033 - .033	.02½ - .03
Bromine, cs., lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	4.50 -	4.50 -	4.50 -
Arsenate, dr., lb.	.07 - .08	.07 - .10	.06½ - .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton	20.00 -	20.00 -	20.00 -
flake, dr., wks., ton	22.75 -	22.75 -	22.75 -
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums, lb.	.05½ - .06	.05½ - .06	.05 - .06
Tetrachloride drums, lb.	.06½ - .07	.06½ - .07	.06½ - .07
Chlorine, liquid, tanks, wks., lb.	.02½ -	.02½ -	.03 -
Cylinders	.04½ - .06	.04½ - .06	.05 - .08
Cobalt oxide, cans, lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	13.00 - 14.00	15.00 - 16.00	16.00 - 17.00
Copper carbonate, bbl., lb.	.10 - .18	.13 - .20	.19 - .21
Cyanide, tech., bbl., lb.	.45 - .46	.49 - .50	.49 - .50
Sulphate, bbl., cwt.	4.75 - 5.00	5.50 - 6.00	6.00 - 6.10
Cream of tartar, bbl., lb.	.26½ - .27	.26½ - .27	.27½ - .28
Diethylene glycol, dr., lb.	.11 - .13	.11 - .13	.10 - .15
Epsom salt, dom., tech., bbl., cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.12½ -	.12½ -	.12.5 -
Formaldehyde, 40%, bbl., lb.	.07½ - .08	.07½ - .08	.09½ - .10
Furfural, dr., contract, lb.	.10 - .12	.10 - .12	.15 - .17
Fusel oil, crude, drums, gal.	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Galubers salt, bags, cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.14 - .14½	.14 - .14½	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb.	.07½ -	.07¾ -	.08¾ -
White, basic sulphate, sck., lb.	.07½ -	.07½ -	.08 -
Red, dry, sck., lb.	.09 -	.09 -	.10½ -
Lead acetate, white crys., bbl., lb.	.13 - .14	.13 - .14	.13 - .13½
Lead arsenate, powd., bbl., lb.	.13 - .14	.13 - .14	.12 - .13
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb.	.08 -	.08 -	.08½ -
Lithopone, bags, lb.	.05½ - .06	.05½ - .06	.05½ - .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06½ - .07
Methanol, 95%, tanks, gal.	.38 -	.38½ -	.55 -
97%, tanks, gal.	.39 -	.39 -	.55 -
Synthetic, tanks, gal.	.40½ - .45	.40½ -	
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Single, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb.	.11 -	.11 -	.12½ -
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.55 - .57
Yellow, cases, lb.	.31 - .32	.31 - .32	.32 - .33
Potassium bichromate, casks, lb.	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½ - .06	.05½ - .06	.05½ - .06
Chlorate, powd., lb.	.08½ - .09	.08½ - .09	.07½ - .08½
Cyanide, cs., lb.	.52 - .55	.52 - .55	.51 - .53
First sorts, csk., lb.	.08½ - .09	.08½ - .09	.08½ - .09
Hydroxide (caustic potash) dr., lb	.06½ - .06¾	.06½ - .06¾	.07½ - .07¾
Muriate, 80% bgs., ton	37.15 -	36.75 -	36.40 -
Nitrate, bbl., lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.15 - .16
Prussiate, yellow, casks, lb.	.18½ - .19½	.18½ - .19	.19 - .19½
Sal ammoniac, white, casks, lb.	.046- .05	.046- .05	.047- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	20.00 - 22.00	22.00 - 24.00	16.00 - 18.00
Soda ash, light, 58%, bags, contract, cwt.	1.32 -	1.32 -	1.32 -
Dense, bags, cwt.	1.35 -	1.35 -	1.35 -
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90 - 3.00	2.90 - 3.00	2.90 - 3.00
Acetate, works, bbl., lb.	.04 - .05	.04 - .05	.05 - .05½
Bicarbonate, bbl., cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton	14.00 - 16.00	16.00 - 18.00	12.00 - 15.00
Bisulphite, bbl., lb.	.03½ - .04	.03½ - .04	.03½ - .04
Chlorate, kegs, lb.	.07½ - .08	.07½ - .08	.06½ - .06½
Chloride, tech., ton	12.00 - 14.75	12.00 - 14.75	12.00 - 14.00
Cyanide, cases, dom., lb.	.18 - .22	.18 - .22	.18 - .22
Fluoride, bbl., lb.	.08½ - .09	.08½ - .09½	.08½ - .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.50 - 3.00
Nitrate, bags, cwt.	2.10 -	2.16 -	2.15 -
Nitrite, casks, lb.	.07½ - .08	.07½ - .08	.07½ - .08
Phosphate, dibasic, bbl., lb.	.03 - .03½	.03 - .03½	.03½ - .03½
Prussiate, yel. drums, lb.	.11½ - .12	.11½ - .12	.11½ - .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.75 - 1.15
Sulphide, fused, 60-62%, dr., lb.	.02½ - .03½	.02½ - .03	.03½ - .04
Sulphite, cyrs., bbl., lb.	.03 - .03½	.03 - .03½	.02½ - .03
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.05 - .06	.04 - .05	.04 - .05
Dioxide, cyl., lb.	.06½ - .07	.07 - .08	.09 - .10
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom. -	nom. -	.14½ -
Oxide, bbl., lb.	.40 -	.60 -	.53 -
Crystals, bbl., lb.	.27½ -	.29½ -	.35 -
Zinc chloride, gran., bbl., lb.	.06½ - .06½	.06½ - .06½	.06½ - .06½
Carbonate, bbl., lb.	.10½ - .11	.10½ - .11	.10 - .11
Cyanide, dr., lb.	.41 - .42	.40 - .41	.40 - .41
Dust, bbl., lb.	.07½ - .08	.08 - .08½	.09 - .10
Zinc oxide, lead free, bag, lb.	.06½ -	.06½ -	.06½ -
5% lead sulphate, bags, lb.	.06½ -	.06½ -	.06½ -
Sulphate, bbl., cwt.	3.00 - 3.25	2.75 - 3.00	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.12 - $0.12½	$0.12 - $0.13	$0.13½ - $0.14
Chinawood oil, bbl., lb.	.09½ -	.10½ -	.14½ -
Coconut oil, Ceylon, tanks, N.Y., lb.	.06½ -	.06½ -	.06½ -
Corn oil crude, tanks, (f.o.b. mill), lb.	.07½ -	.07½ -	.08½ -
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.07 -	.07½ -	.08 -
Linseed oil, raw, car lots, bbl., lb.	.14½ -	.14 -	.10.4 -
Palm, Lagos, casks, lb.	.07 -	.07 -	.08½ -
Niger, casks, lb.	.06½ -	.06½ -	.08 -
Palm Kernel, bbl., lb.	.07½ -	.07½ -	.08½ -
Peanut oil, crude, tanks (mill), lb	.07½ -	.07½ -	.08½ -
Rapeseed oil, refined, bbl., gal.	.70 - .72	.70 - .72	.82 - .84
Soya bean, tank (f.o.b. Coast), lb.	.09½ -	.09½ -	.09½ -
Sulphur (olive foots), bbl., lb.	.07½ -	.07½ -	.10½ -
Cod, Newfoundland, bbl., gal.	.55 - .57	.55 - .57	.65 - .67
Menhaden, light pressed, bbl., gal.	.63 - .65	.63 - .65	.70 - .72
Crude, tanks (f.o.b. factory), gal.	nom. -	nom. -	.48 -
Whale, crude, tanks, gal.	.78 -	.78 -	- .80
Grease, yellow, loose, lb.	.04½ -	.05½ -	.07 -
Oleo stearine, lb.	.08½ -	.9½ -	.09½ -
Red oil, distilled, d.p. bbl., lb.	.10½ -	.10 -	.09½ - .09½
Tallow, extra, loose, lb.	.05½ -	.06½ -	.08½ -

Coal Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 - $0.65	$0.60 - $0.65	$0.60 - $0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra, lb.	.15 - .15½	.15 - .15½	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums, lb.	.60 - .65	.60 - .65	.60 - .65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.70 - .72
Benzoic acid, U.S.P., kgs, lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.21 - .23	.22 - .24	.22 - .23
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.60 - .70	.60 - .70	.73 - .75
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoleun, bbl., lb.	.16 - .17	.16 - .17	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.	.39 - .40	.39 - .40	.45 - .47
H-acid, bbl., lb.	.68 - .70	.68 - .70	.63 - .65
Naphthalene, flake, bbl., lb.	.04½- .05	.04½- .05	.05 - .06
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.52 - .53
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.14½- .15	.14½- .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.80	1.79 - 1.90	1.35 - 1.50
R-salt, bbl., lb.	.44 - .45	.44 - .45	.47 - .49
Resorcinal, tech., kegs, lb.	1.15 - 1.25	1.15 - 1.25	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.30 - .32
Solvent naphtha, w.w., tanks, gal	.28 - .30	.28 -.....	.35 -.....
Tolidine, bbl., lb.	.91 - .93	.91 - .93	.95 - .96
Toluene, tanks, works, gal.	.35 -	.35 -.....	.35 -.....
Xylene, com., tanks, gal.	.25 - .28	.28 - .30	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.13½- .16	.14 - .15	.16 - .17
China clay, dom., f.o.b. mine, ton	8.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.05 - .22	.05 - .22	.06½- .07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.31 - .32
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.03 - .35
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	6.00 - 6.50	6.00 - 6.50	5.25 - 5.50
Para toner, lb.	.77 - .80	.77 - .80	.70 - .80
Vermilion, English, bbl., lb.	1.90 - 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl., lb.	.17 - .17½	.17 - .17½	.15½- .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.04 - .05	.04 - .05	.08 - .09
Cum copal Congo, bags, lb.	.07 - .09	.07½- .08	.07½- .08
Manila, bags, lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, cases, lb.	.16 - .16½	.18 - .19	.22 - .23
Kauri No. 1 cases, lb.	.48 - .50	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.), lb.	50.00 -55.00	50.00 -55.00	50.00 - 55.00
Magnesite, calc, ton	40.00 -.....	40.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	6.90 -.....	7.10 -.....	8.45 -.....
Turpentine, gal.	.47 -.....	.48 -.....	.54 -.....
Shellac, orange, fine, bags, lb.	.50 - .52	.50 - .52	.61 - .62
Bleached, bonedry, bags, lb.	.36 - .37	.36 - .37	.56 - .60
T. N. bags, lb.	.27 - .28	.27 - .28	.46 - .47
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	9.50 -.....	9.50 -.....	10.50 -.....
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -.....	13.75 -.....	13.75 -.....
Wax, Bayberry, bbl., lb.	$0.23 -$0.25	$0.27 $0.29	$0.31 -$0.32
Beeswax, ref., light, lb.	.34 - .37	.34 - .37	.41 - .42
Candelilla, bags, lb.	.19 - .20	.19 - .20	.23 - .24
Carnauba, No. 1, bags, lb.	.30 - .31	.31 - .32	.50 - .51
Paraffine, crude 105-110 m.p., lb.	.04 - .04½	.04½- .05	.04½- .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200 00-	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton	94 00-99 00	94.00-99.00	105 00-.....
Spiegeleisen, 19-21%, ton	33.00-....	33.00-.....	32.00-.....
Ferrosilicon, 14-17%, ton	45.00-....	45.00-.....	45.00-.....
Ferrotungsten, 70-80%, lb.	1.45	1.45-.....	1.35- ...
Ferro-uranium, 35-50%, lb.	4.50-....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%, lb.	3.15- 3.50	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.12¼-.....	$0.12½ -.....	$0.18 -.....
Aluminum, 96-99%, lb.	.24 - .30	.24 - .26	.24 - .25
Antimony, Chin. and Jap., lb.	.07½-.....	.07½-.....	.09½- ....
Nickel, 99%, lb.	35 -.....	35 -.....	35 -.....
Monel metal, blocks, lb.	28 -.....	28 -.....	28 -.....
Tin, 5-ton lots, Straits, lb.	.31½-.....	31½- ...	44½-.....
Lead, New York, spot, lb.	.055.....	0545	.07 -.....
Zinc, New York, spot, lb.	.0485.....	.05 -.....	.07 -.....
Silver, commercial, oz.	.42½-.....	42½-.....	.52½-.....
Cadmium, lb.	.70 - .75	.70 - .75	.85 - .95
Bismuth, ton lots, lb.	1.00 -	1.28 -.....	1.70 -.....
Cobalt, lb.	2.50 -	2.10 - 2.50	2.50 -.....
Magnesium, ingots, 99%, lb.	.85 - 1.10	.85 - 1.10	.85 - 1.10
Platinum, ref., oz.	46.00- 48.00	46.00- 48.00	70.00-70.00
Palladium ref., oz.	26.00- 28.00	30.00- 35.00	42.00-46.00
Mercury, flask, 75 lb.	120.00-.....	112.00-.....	123.00-.....
Tungsten powder, lb.	1.70- 1.75	1.35- 1.50	1.10- 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$7.50- $8.00	$7.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post, ton	21.50- 25.00	21.50- 25.00	22.00- 23.00
Coke, fdry., f.o.b. ovens, ton	2.75- 2.85	2.75- 3.85	2.85- 3.00
Fluorspar, gravel, f.o.b. Ill., ton	18.00- 20.00	18.00- 20.00	17.00- 18.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	31 - 36	31 - 36	.36 - 38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.48 - .50	.48 - 50	.48- .50
Monazite, 6% of ThO_2, ton	60.00-.....	60.00-.....	130.00-.....
Pyrites, Span. fines, c.i.f., unit	.13 -.....	.13 -.....	.13 -.....
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit	15.25- 16.50	15.25 -16.50	11.25 -11.50
Zircon, 99%, lb.	.03 -.....	.03 -.....	.03 -.....

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Abrasive Manufacturing Plant—Norton Co. Ltd., Chippewa, Ont., awarded contract for a 2 story addition to abrasive manufacturing plant to Smith Bros. Construction Co., Niagara Falls, Ont. Estimated cost $60,000.

Acetylene Producing Plant—Prest-O-Lite Co. Inc., subsidiary of Linde Air Products Co., 30 East 42nd St., New York, will soon receive bids for a 1 story acetylene producing plant on 17th St. N. E., Canton, O. Estimated cost $50,000. Also awarded contract for a 100 x 185 ft. plant at Spokane, Wash., to S. G. Morin, Spokane. $65,000.

Asbestos and Rubber Products Factory — Palmer Asbestos & Rubber Co., 2741 Clybourn Ave., Chicago, Ill., plans the construction of first unit of plant for the manufacture of mechanical rubber goods and asbestos brake lining, etc. at St. Matthews, near Louisville, Ky. Estimated total cost $1,000,000.

Borax Plant—Western Borax Co., 417 South Hill St., Los Angeles, Calif., awarded contract for a 73 x 110 and 73 x 120 ft. factory, including six 1,000 bbl. capacity steel tanks at Baggett to Consolidated Steel Corp., 1200 North Main St., Los Angeles.

Brass Foundry—Brooklyn Brass Works, L. Meier, Pres., Brooklyn, N. Y., will receive bids about July 1 for the construction of a foundry at Scholes and Waterbury Sts. Estimated cost $40,000. Lee & Hewitt, 53 Park Pl., New York, are architects.

Brass Tube Mill—American Brass Co., Grand and Meadow Sts., Waterbury, Conn., awarded contract for a 1 story, 140 x 160 and 140 x 205 ft. brass tube mill on South Main St., to Oscar LaCroix Construction Co., 51 West Main St., Waterbury. Estimated cost $300,000.

Carbide and Carbon Plant—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for the construction of a plant at Reid Highway, Detroit, Mich., to Walbridge Aldinger Co., 1300 Buhl Bldg., Detroit. Estimated cost to exceed $60,000.

Carbon Plant — National Carbon Co., R. C. Frazer, Purch. Agt., West 117th St. and Madison Ave., Cleveland, O., awarded contract for a 1 story addition to factory on West 76th St. to Gillmore Carmichael Olson Co., 4300 Euclid Ave., Cleveland. Estimated cost $40,000.

Calcium Chloride, Soap, Copper Paint, Etc.—A. L. Flint, General Purchasing Officer of the Panama Canal, Washington, D. C., will receive bids until June 27 for calcium chloride, soap, copper paint, indian red, varnish, titanium pigment, etc.

Cement Storage Plant—Aetna Portland Cement Co., Bay City, Mich., awarded contract for the construction of a 1 story cement storage plant, including four silos, 30 ft. in diameter and 80 ft. high with necessary handling and conveying equipment to MacDonald Engineering Co., 53 West Jackson St., Chicago, Ill. Estimated cost $75,000.

Chemical Plant — Allied Tar & Chemical Corp., D. W. Blaine, V. Pres. and Gen. Mgr., South Bayway, Elizabeth, N. J., plans to rebuild plant destroyed by fire. Estimated cost $40,000. Architect not selected.

Chemical Plant — Hoffman La Roche Inc., Kingsland Rd., Nutley, N. J., awarded contract for 5 story, 35 x 65 ft. and 1 story, 75 x 108

ft. chemical plant on Kingsland Rd. to John W. Ferguson Co., 152 Market St., Paterson. Estimated cost $65,000.

Chemical Plant Unit — Merrimac Chemical Co., S. Wilde, Pres., Everett, Mass., awarded contract for the construction of a 1 story, 65 x 140 ft. locker building, to J. F. Griffin Co., 250 Stuart St., Boston. $40,000. Also 3 story, 85 x 110 ft. sulphur acid plant at Chemical Lane, Everett, to Leonard Construction Co., 37 South Wabash Ave., Chicago, Ill. $50,000.

Fertilizer Plant—Grasselli Chemical Co. Ltd., Federal Bldg., Toronto, Ont., awarded contract for the construction of a 1 story, 117 x 240 ft. fertilizer plant at Hamilton, to Anglin-Norcross Ltd., Temple Bldg., Toronto. Estimated total cost $200,000.

Fertilizer Manufacturing Equipment—Canadian Industries, E. H. Jordan, Mgr., Hamilton, Ont., plans the installation of additional special equipment for the manufacture of fertilizers.

Distillery—Dunrobin Distilling Co., Grimsby, Ont., plans additional unit to plant, 6 story, 60 x 175 ft. Estimated cost $50,000. Private plans.

Drug and Perfume Plant—Connecticut Drug & Perfume Co., 108 State St., New Haven, Conn., is receiving bids for a 4 story, 50 x 200 ft. plant on Orange Ave., West Haven. Estimated cost $160,000. J. Weinstein, Metropolitan Bldg., New Haven, is architect.

Enameling Plant — Erie Enameling Co., W. Spence, West 20th St., Erie, Pa., awarded contract for a 1 story, 60 x 120 ft. enameling plant, to E. E. Austin & Son, 20th and Reed Sts., Erie.

Galvanizing Plant—Westinghouse Electric & Mfg. Co., W. H. Freiner, Supt. of Constn., West 54th St., Cleveland, O., will soon award contract for a 1 story, 60 x 80 ft. galvanizing plant. Estimated cost $40,000. Private plans.

Gas Plant—City of Guthrie, Okla., plans an election soon to vote $225,000 bonds for the construction of a gas plant.

Gas Plant—Consolidated Gas Co., 4 Irving Pl., New York, N. Y., will soon award contract for the construction of and equipment for water gas plant at Hunts Point. Estimated cost $10,500,000. Contract let for thirty-four coke-gas ovens to Koppers Co., Koppers Bldg., Pittsburgh, Pa.

Gas Plant—Ethane Carbon Co., Texon, Tex., has been granted permit to construct a plant to burn residue gas for a number of casinghead gasoline plants in operation in Reagan fields, Reagan county. Will require 1,000,000 cu.ft. of residue casinghead gas daily. $150,000. Private plans. Equipment will be installed.

Gas Manufacturing Plant—Tennessee Gas Co., Murfreesboro, Tenn., subsidiary of Utilities Gas & Electric Co., 22 West Monroe St., Chicago, Ill., plans the construction of a gas manufacturing plant at Murfreesboro, Tenn. Estimated cost $150,000. Work will be done by owner's forces.

Glass Plant — Ford Motor Co., Dearborn, Mich., is having plans prepared for a 1 story glass plant at Rouge River. Estimated cost $50,000. Giffels & Vallet, 604 Marquette Bldg., Detroit, are engineers. Equipment will be installed.

Glass Plant — Fostoria Glass Co., Moundsville, W. Va., awarded contract for a 4 story, 90 x 140 ft. factory, to C. Shimp, Wheeling, W. Va. Estimated cost $100,000.

Glass Plant — Owner, c/o American Plate Glass Co., A. H. Gaffney, Pres., Kane, Pa., and Indestructo Glass Corp., 527 5th Ave., New York, N. Y., plans the construction of a glass plant at Kane. Estimated cost $2,000,000. Architect not selected.

Glass Plant—Three Rivers Glass Co., Three Rivers, Tex., plans extensions and improvements to plant at Three Rivers, also having surveys made for probable establishment of a new plant at some point in South Texas. Private plans.

Glass Distribution Plant — Pittsburg Plate Glass Co., 26 Mill St., New Haven, Conn., will soon award contract for a 2 story, 100 x 120 ft. glass distribution plant and office on Spencer St. Estimated cost $100,000. Private plans.

Gold Mill—Dome Mines Ltd., South Porcupine, Ont., awarded contract for the construction of a 1,500 ton gold mill to Hill-Clarke-Francis, New Liskeard, Ont. Estimated total cost $500,000.

Manganese Mining Plant—Oacoma Corp., W. Gordon, Sioux City, Ia., plans the construction of a hydro-electric plant on the Missouri River near Oacoma and Chamberlain to furnish power for a manganese mining plant to be operated by General Manganese Corp., Detroit, Mich. This corporation (Manganese) has acquired 200,000 acres of land near Oacoma and Chamberlain and has leased 125,000 acres additional.

Chemistry Building—University of California, Los Angeles, Calif., will soon receive bids for the construction of a chemistry and insectary building at Riverside. Estimated cost $150,000. G. S. Wilson, 3636 West 9th St., Riverside, is architect.

Laboratory (Chemistry) — Fisk University, 17th Ave. N., Nashville, Tenn., is having tentative plans made for the construction of a chemistry building on Campus. Estimated cost $300,000.

Laboratory (Chemistry) — Phillips Exeter Academy, Exeter, N. H., will soon receive bids for a 2 story chemistry laboratory on campus. Estimated cost $40,000. Cram & Ferguson, 248 Boylston St., Boston, Mass., are architects.

Laboratory (Chemistry) — School Commissioners, Glasgow, Ky., is having plans prepared for the construction of a 2 story, 75 x 112 ft. school, including chemistry laboratory, etc. Estimated cost $150,000. H. E. Boyle & Co., Furniture Bldg., Evansville, Ind., are architects.

Laboratory (Chemical)—Huntington Laboratory, Huntington, Ind., is having revised plans prepared for a chemical laboratory on East Lipton St. Estimated cost $44,000. Alexander & Brandt, 64 East Jackson Blvd., Chicago, Ill., are architects.

Laboratory (Film)—DuPont-Pathe Film Mfg. Corp., Parlin, N. J., awarded contract for the construction of a 1 story laboratory to Wigton-Abbott Corp., 552 West 23rd St., New York, N. Y. Estimated cost $40,000.

Laboratory (Research)—Mellon Institute of Industrial Research, E. R. Weidlein, Dr., Thackery and O'Hara Sts., Pittsburgh, Pa., awarded contract for the construction of a 7 story, 300 x 400 ft. research laboratory to Mellon Stuart Co., Oliver Bldg., Pittsburgh. Estimated cost $4,000,000.

Laboratory — Barber Asphalt Co., Maurer, N. J., awarded contract for a 3 story, 50 x 120 ft. laboratory and engineering building to Morrison & Sherman Inc., 675 Garden St., Elizabeth. Estimated cost $130,000.

Laboratory—Dept. of Agriculture, Washington, D. C., awarded contract for the construction of a laboratory at fairgrounds, Albany, Ga., to A. C. Knight, Albany.

Laboratories—Bd. of Education, Gary, Ind., will receive bids until July 1 for the construction of a 3 story high school including laboratories, etc. at 46th and Madison Sts. Estimated cost $1,000,000. W. B. Ittner Inc., Continental Life Bldg., St. Louis, Mo., is architect.

Laboratories — Pennsylvania College for Women, Woodland Rd., Pittsburgh, Pa., awarded contract for a group of buildings, including chemical and biology laboratories, etc., to W. T. Grange Construction Co., Keenan Bldg., Pittsburgh. Estimated cost $500,000.

Leather Factory Addition—J. S. Barnet & Sons, 126 Boston St., Lynn, Mass., awarded contract for a 1 story, 50 x 200 ft. leather factory to Bond Bros., 79 Ferry St., Everett. Estimated cost $40,000.

Linoleum Plant — Neidick Process Co., Burlington, N. J., awarded contract for a 3 story, 60 x 128 ft. factory to Karno Smith Construction Co., Broad St. Bank Bldg., Trenton.

Oxygen Plant—Indiana Oxygen Co., 439 Harman St., Indianapolis, Ind., awarded contract for a 2 story, 88 x 195 ft. factory at Delaware and Henry Sts., to R. Fatout, 625 Bd. of Trade Bldg., Indianapolis. Estimated cost $52,000.

Oxygen, Nitrogen and Hydrogen Plant—General Electric Co., Witherspoon Bldg., Philadelphia, Pa., awarded contract for the construction of a 1 story, 40 x 80 ft. addition to plant for the manufacture of oxygen, nitrogen and hydrogen on Winter St., Fort Wayne, Ind., to Indiana Engineering & Construction Co., 201-3 Central Bldg., Fort Wayne. Contract let for gas holders.

Paint and Enamel Factory — Wailes Dove-Hermiston Corp., 17 Battery Pl., New York, N. Y., awarded contract for a 1 story, 50 x 260 ft. plant for the manufacture of bitumastic paint, a non-corrosive paint used for gas pipe lines, etc., at 29th St. and Illinois Ave., to W. H. and N. Cunliff Co., 3327 Lindell Blvd., St. Louis, Mo. Estimated cost $100,000.

Paint Factory—Gilbert Spruance Co., Richmond and Tioga Sts., Philadelphia, Pa., will soon award contract for a 2 story, 63 x 105 ft. paint factory at Kingston and Richmond Sts. Estimated cost $80,000. C. E. Wunder, 1520 Locust St., Philadelphia, is architect.

Paint Factory Addition—United Color & Pigment Co., Evergreen Ave., Newark, N. J., awarded contract for alterations and addition to paint factory, 3 story, 50 x 105 ft. at 158 Mt. Olivet Ave., to Adams-Faber Co., 247 Lorraine Ave., Upper Montcalir. Estimated cost $45,000.

Paper Plant — Hinde & Dauch Paper Co., Sandusky, O., awarded contract for the construction of a 1 story, 240 x 480 ft. paper plant at Biddle St. near Loney's Lane to O. Randolph, Inc., 53 West Jackson Blvd., Chicago. Estimated cost $400,000.

Paper Mill—Crocker, Burbank & Co., Inc., 545 Westminster St., Fitchburg, Mass., awarded contract for a paper mill to Wiley & Foss, Central St., Fitchburg, Mass. Estimated cost to exceed $100,000.

Paper Mill — Northwest Paper Co., H. N. Hornby, Pres., Cloquet, Minn., awarded contract for a 1 story, 125 x 724 ft. addition to paper mill including machine, heater, finishing and pulp storage rooms to J. Lecke Co., 211 South 11th St., Minneapolis. Estimated cost $350,000.

Paper Mill—Oregon Pulp & Paper Co., Salem, Ore., plans the construction of a paper mill. Estimated cost $60,000.

Pottery Plant—Trenton Potteries Co., North Clinton St., Trenton, N. J., will soon award contract for a 1 story addition to factory at North Clinton Ave. between Ott St. and Dewey Ave. Estimated cost $40,000. Lockwood, Green Engineers, Inc., 100 East 42nd St., New York, N. Y., are architects and engineers.

Quartz Plant—Philadelphia Quartz Co., 6th and Grayson Sts., Berkeley, Calif., awarded contract for the construction of a factory at Grayson St., to W. E. Lyon, 354 Hobart St., Oakland. Estimated cost $15,000.

Rayon Plant—Industrial Rayon Corp., H. S. Rivitz, Pres., West 98th St. and Walford Ave., Cleveland, O., will soon award contract for a group of factory buildings in connection with rayon plant at Covington, Va. Estimated cost $750,000. Christian, Schwarzenberg & Gaede, 1836 Euclid Ave., Cleveland, O., are architects and engineers.

Bulk Storage Building and Refinery — Gulf Refining Co., Frick Annex, Pittsburgh, Pa., awarded contract for the construction of a bulk storage building at Port Richmond, Staten Island, N. Y., to United Engineers & Constructors, Inc., 125 East 46th St., New York. $2,000,000. Also plans addition to refinery at Drennan Ave. and Keller Rd., Fort Worth, Tex., $200,000., will receive bids in spring of 1931 for warehouse, pier, tanks, etc. on Oak St., Bayonne, N. J.

Compound Plant—Cities Service Refining Co., 345 Quincy Ave., Braintree, Mass., awarded contract for the construction of a 1 story compound plant to Clark & Smith, 13 Temple St., Quincy. Estimated cost $40,000.

Gasoline Plant — Phillips Petroleum Co., Bartlesville, Okla., and Amarillo, Tex., plans the construction of a natural gasoline plant, including two distillation units and a 21 unit compressor plant of 4,095 hp. in Gray County, Tex. Estimated cost $350,000. Most of work will be odne by owner's forces.

Refinery (Oil)—National Consumers Oil Co., Terre Haute, Ind., plans the construction of an oil refinery, warehouse and river terminal, six storage tanks and a number of filling stations at Louisville, Ky. Estimated cost $250,000.

Refinery (Oil)—Navajo Refining Co., c/o F. Jackson, 109 Hot Wells Blvd., San Antonio and G. E. McQuillen, Amarillo, Tex., now being organized, plans a crude oil refinery, 3500 bbl. capacity at Kings Mill. Private plans.

Refinery (Oil)—Union Oil Co., L. G. Metcalf, Mgr., Wilmington, Calif., awarded contract for a 1 story, 130 x 180 ft. oil refinery to John Simpson & Co., 701 Antonio St., Los Angeles. Estimated cost $600,000.

Refractories Plant—Stockton Fire Brick Co., Russ Bldg., San Francisco, Calif., is having plans prepared for first unit of refractories plant at Pittsburg. Estimated cost $500,000. Private plans. Equipment including conveyors, etc. will be installed.

Rubber Plant—U. S. Rubber Co., Broadway and 58th St., New York, N. Y., plans additions and alterations to plant for the manufacture of cord for making tires at Winnsboro, S. C. Estimated cost to exceed $40,000. Work will be done by separate contracts and day labor.

Salt Mine—Louisiana Development Co., Winfield, La., awarded contract for sinking shaft for salt mine, inside diameter, 14 ft. and 740 ft. deep to Dravo Contracting Co., Penn Ave., Pittsburgh, Pa., $250,000.

Salt Works—Solvay Process Co., Solvay, N. Y., will build a pipe line to carry brine from Tully salt wells to plant at Solvay. Estimated cost $1,000,000. Work will be done by owners forces.

Smelting Plant—White Bros. Smelting Corp., Richmond and Hedley Sts., Philadelphia, Pa., plans the construction of a 1 story, 60 x 160 ft. smelting plant at Hedley and Myrtle Sts. Estimated cost $30,000. Private plans.

Crushing Plant—Los Angeles Soap Co. and Griffith Co., Los Angeles Railway Bldg., Los Angeles, Calif., awarded contract for a 1 story, 40 x 340 ft. crushing plant to Consolidated Steel Corp., 1200 North Main St., Los Angeles. Estimated cost $50,000.

Soap Factory—Champion Soap Co., 351 Canal Pl., New York, N. Y., is having sketches made for the construction of a warehouse and garage at 140th St. and Canal Pl. Estimated cost $40,000. G. W. Kibity, 633 King Ave., New York, is architect.

Soap Factory — Colgate Palmolive Peet Co., 919 North Michigan Ave., Chicago, Ill., awarded masonry and carpentry contracts for a soap factory. Estimated cost $135,000.

Starch Factory—Canada Starch Co., Cardinal, Ont., awarded contract for six storage silos, 80 ft. high in connection with starch factory to MacDonald Engineering Co., Canadian Pacific Bldg., Toronto. Estimated cost $125,000.

Blast Furnaces—Colorado Fuel & Iron Co., c/o W. A. Maxwell, Jr., Mgr., Pueblo, Colo., has work under way on remodeling of blast furnaces in connection with steel plant improvements. Estimated cost $200,000. Work being done by day labor.

Steel Foundry—Ohio Steel Foundry Co., Bay City, Mich., awarded contract for a 1 story, 70 x 70 ft. addition to foundry to Henry C. Weber Co., Bay City. Estimated cost $75,000. Open hearth furnaces will be installed.

Tobacco Plant—Imperial Tobacco Co. L'td., H. O. 3810 St. Antoine St., Montreal, Que., awarded contract for a 1 story, 100 x 440 ft. plant at Delhi, Ont., to Stevens & Scott, Tilsonburg, Ont. Estimated cost $75,000.

Vitrified Products Plant — Ontario Vitrified Products Co., 34 King St. E., Toronto, Ont., plans the construction of a plant at Salisbury Ave. and Lake Shore Rd. in Etobicoke township. Estimated cost $50,000. Private plans.

Tile Factory—Albree Marble & Tile Co., Inc., 9 Ashland St., Dorchester, Mass., is having plans prepared for a 1 story, 100 x 100 ft. factory. Estimated cost $50,000. W. P. Hatch, 60 State St., Boston, is architect.